DRAFT FINAL REPORT

BASELINE RISK ASSESSMENT
95TH TERRACE SITE

DEPARTMENT OF ENERGY
KANSAS CITY PLANT
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EXECUTIVE SUMMARY

The primary goal of a baseline Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) is to provide an evaluation of the potential health risks associated with current and future exposure to chemicals at a site in the absence of any remedial action. The HHRA characterizes the nature of the chemical releases from the site and evaluates potential pathways for human exposure. The ERA characterizes potential risks to ecological receptors associated with chemical releases from the site.

HUMAN HEALTH RISK ASSESSMENT

This HHRA was performed using guidelines provided in the Risk assessment Guidance for Superfund, Volume I: Human Health Evaluation, Part A (RAGS: EPA 1989) and Risk Assessment Handbook: Human Health Evaluation (USACE 1995). Additional guidance documents used to conduct the Draft HHRA include the Superfund Exposure Assessment Manual (SEAM) (EPA 1988), Exposure Factors Handbook (EPA 1997a), Standard Default Exposure Factors (EPA 1991a), Dermal Exposure Assessment Principles and Applications (EPA 1992a), EPA Region IV guidance (EPA 1991b, 1994c).

The area of potential concern evaluated in this HHRA is the 95^{th} Terrace Site, Storm water 002 Outfall, and Indian Creek. The 002 Outfall box culvert, raceway, and outlet currently lie within the old abandoned Indian Creek streambed. Polychlorinated biphenyls (PCBs) are the only chemicals of potential concern evaluated in this HHRA.

Media of Concern

Environmental media evaluated in the HHRA included shallow and deep soils near 95^{th} Terrace, sediments within the old abandoned Indian Creek streambed, sediments in Indian Creek near the Stormwater 002 Outfall, surface water associated with the Stormwater 002 Outfall, surface water in Indian Creek (adjacent and downstream from Stormwater 002 Outfall), and fish from Indian Creek and downstream in Blue River.

Receptor Populations and Exposure Pathways

Excavation workers were assumed exposed (via ingestion and dermal contact) to contaminated deep soils (>10 feet bgs) at the 95^{th} Terrace Site. Potential activities for this receptor would include trenching, roadwork, culvert repair, etc.

Utility worker were assumed to be exposed (via ingestion and dermal contact) to contaminated shallow soils (0-10 feet) at the 95^{th} Terrace site. Potential activities for this receptor include utility maintenance and repair.

Construction workers were assumed exposed (via ingestion and dermal contact) to sediments associated with Stormwater 002 Outfall and Indian Creek. Construction workers were also assumed to be exposed to surface water in the 002 Outfall box culvert, 002 Outfall outlet, and Indian Creek. This population was assumed exposed during culvert repair, roadwork, etc. This population was considered protective of intermittent receptors (i.e., first responders, emergency workers, etc.) who might have to perform duties in the area.

Adult and child recreational receptors were assumed exposed (via ingestion and dermal contact) to sediment, surface water, and fish associated with the 002 Outfall and Indian Creek. Exposure was assumed to occur while fishing or wading near the 002 Outfall or in Indian Creek/Blue River.

HHRA Results

Excavation Worker

The excavation worker was assumed to be exposed (via ingestion and dermal contact) to contaminated deep soils. The excavation workers were assumed to be exposed for 8 hours/day, 15 and 30 days/year, over 1 year for the central tendency and Reasonable Maximum Exposure (RME) cases, respectively. These assumptions are conservative because it is unlikely that any trenching activities at the 95th Terrace Site would take 15 or more days to complete.

The total Hazard Index (HI) calculated for noncarcinogenic health effects due to multiple-pathway subchronic exposure to deep soils via the ingestion and dermal contact pathways is 0.01 and 0.1 in the central tendency and RME cases, respectively. Both the central tendency and RME HIs are below the EPA target value of 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 1×10^{-8} in the central tendency case and 3×10^{-7} in the RME case. Both the central tendency and RME excess cancer levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Utility Worker

The utility worker was assumed to be exposed (via ingestion and dermal contact) to shallow soils at the 95th Terrace site. The utility workers were assumed to be exposed 8 hours/day, 15 and 30 day per year over 1 year for the central tendency and RME cases, respectively. These assumptions are conservative because it is unlikely that any utility work at the 95th Terrace site would take 15 days or more to complete.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway subchronic exposure to shallow soils via ingestion and dermal contact pathways is 0.03 and 0.33 in the central tendency and RME cases, respectively. Both the central tendency and RME His are below the EPA target value of 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 2×10^{-9} in the central tendency case and 5×10^{-8} in the RME case. Both the central tendency and RME excess cancer levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Construction Worker

The construction worker was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water. The construction workers were assumed to be exposed for 8 hours/day, 15 and 30 days/year, over 1 year for the central tendency and RME cases, respectively. These assumptions are conservative because it is unlikely that any construction activities associated with Stormwater 002 Outfall and Indian Creek would take 15 or more days to complete.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway subchronic exposure to sediments and surface water via the ingestion and dermal contact pathways is 7.1 and 66 in the central tendency and RME cases, respectively. Both the central tendency and RME HIs exceed the EPA target value of 1.0. Dermal contact with Aroclor 1242 in sediments was the primary contributor to the HI. However, dermal contact with surface water and ingestion of Aroclor 1242 in sediments also had HI values greater than 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 5×10^{-7} in the central tendency case and 9×10^{-6} in the RME case. Both the central tendency and RME excess cancer levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Adult Recreational Receptor

The adult recreational receptor was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water at Stormwater 002 Outfall/Indian Creek. The adult recreational receptor was assumed to be exposed for 2 to 4 hours/day, 26 to 52 days/year, over 9 and 30 years for the central tendency and RME cases, respectively. Adult recreational receptors were also assumed to ingest 16 and 45.2 grams/day of fish, in the central tendency and RME cases respectively. This scenario assumes that the fraction of contaminated fish is 10 percent in the average case and the 25 percent in the RME case. These assumptions are conservative because it is unlikely that an adult would visit the area 2 to 3 times per week for 9 to 30 years. Additionally, while Indian Creek supports a fish population, it does not support a large fish population.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway chronic exposure to contaminated sediments, surface water and fish via the ingestion and dermal contact pathways is 1.0 and 7.7 in the central tendency and RME cases, respectively. The central tendency value does not exceed the EPA target value of 1.0. The RME HI exceeds the EPA target value of 1.0. Ingestion of Aroclor 1254 in channel catfish was the major contributor to the HI. However, the RME value for dermal contact with surface water also exceeds 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 5×10^{-6} in the central tendency case and 9×10^{-5} in the RME case. Both the central tendency and RME levels are within the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Child Recreational Receptor

The child recreational receptor was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water at Stormwater 002 Outfall/Indian Creek. The child recreational receptor was assumed to be exposed for 2 to 4 hours/day, 26 to 52 days/year, over 9 years for the central tendency and RME cases, respectively. Child recreational receptors were also assumed to ingest 8 and 23 grams/day of fish, in the central tendency and RME cases, respectively. This scenario assumes that the fraction of contaminated fish is 10 percent in the central tendency case and the 25 percent in the RME case. These assumptions are conservative because it is unlikely that a child would visit 002 Outfall/Indian Creek 2 to 3 times per week for 9 years.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway chronic exposure to PCBs in sediments, surface water and fish via the ingestion and dermal contact pathways is 1.0 and 7.8 in the central tendency and RME cases, respectively. The RME HI exceeds the EPA target value of 1.0. Ingestion of Aroclor 1254 in channel catfish was the primary contributor to the HI. However, dermal contact with Aroclor 1242 in surface water also had a hazard quotient greater than 1.0 (2.69).

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 4×10^{-6} in the central tendency case and 4×10^{-5} in the RME case. Both the central tendency and RME level are within the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

ECOLOGICAL RISK ASSESSMENT

The primary guidance used for the Ecological Risk Assessment (ERA) was the *Guidelines for Ecological Risk Assessment* (EPA 1998). The ERA was conducted as a "desk-top" evaluation using existing information, and consisted of three major components: (1) *Problem Formulation*; (2) *Risk Analysis*; and (3) *Risk Characterization.*

Problem Formulation

Problem Formulation is the process of establishing the goals, breadth and focus of the ecological risk assessment. PCBs were the chemicals of potential ecological concern (COPECs) evaluated in the ERA.

There are two interrelated ecosystems potentially at risk in the study area: (1) the aquatic portions of Indian Creek and Blue River; and (2) the "terrestrial" system that comprises the adjacent riparian corridor. Receptors associated with these streams include both strictly-aquatic and semiaquatic forms. Strictly aquatic organisms are defined as plants and animals adapted to total living in water (such as aquatic vegetation and fish), whereas semiaquatic forms are air-breathing organisms adapted to life in or near water, such as some reptiles and amphibians (e.g., turtles and frogs), wading birds (e.g., heron) and some mammals that feed upon aquatic organisms (e.g., raccoon and mink).

Potential media of concern evaluated in the ERA included surface water, sediments, and biological tissue in Indian Creek and Blue River. Though soils in the 95th Terrace Site were initially considered as well, they were not carried through the ERA because potential exposures were limited to low concentrations (0.44 mg/kg) in a very small area. Though higher concentrations were observed at depths greater than about 5 ft, these were not considered complete exposure pathways to ecological receptors.

Potential exposure pathways to ecological receptors include direct contact and ingestion of media that may contain PCBs. Ingestion pathway exposures are of particular interest with regard to PCBs because of their propensity for bioaccumulation and biomagnification in the food chain. Inhalation is also a potential exposure pathway for vertebrate receptors. However, because PCBs have low volatility and the environment being evaluated is aquatic, inhalation exposures were not considered significant.

Among the crucial products of problem formulation are assessment endpoints, which provide a bridge between broad management or policy goals (e.g., "protection of the environment") and the specific measurements used to evaluate risk in the assessment. Information on the ecosystem, the nature and extent of contamination, and the environmental chemistry and toxicity of PCBs were used to select assessment endpoints.

Biological communities considered ecologically relevant in Indian Creek and Blue River included aquatic vegetation, plankton, benthic macroinvertebrates, fish, amphibians, reptiles, mammals and birds. Aquatic vegetation was not selected as an assessment endpoint because of its comparative resistance to toxicity associated with PCBs. Fish and benthic macroinvertebrates were not selected as assessment endpoints because existing information indicates these communities are similar to other areas in Indian Creek and Blue River not impacted by releases associated with Outfall 002 and the 95th Terrace Site. PCBs have not been detected in surface water of Indian Creek or Blue River. In sediments, PCBs have only been detected within a short distance of the 002 Outfall (samples collected 100 m downstream and elsewhere in Indian Creek and Blue River were nondetect). Measured PCB concentrations in fish tissue, and estimated tissue PCB concentrations in benthic macroinvertebrates, are also below concentrations associated with potential impacts to reproduction and growth. Amphibians and reptiles were not selected because of the practical limitations of available ecotoxicological data. For ingestion-pathway exposures, little to no oral toxicity data are available for amphibians or reptiles for most chemicals. Though there may be adequate knowledge of an animal's behavior and physiology to estimate exposures with reasonable accuracy, it is of limited practical value to do so if there is no basis for evaluating the consequences of the exposures. Ingestion pathway exposures to semiaquatic birds and mammals were ultimately identified as the key assessment endpoints for the ERA. Because of the potential biomagnifying properties of PCBs, the exposure pathways of import are ingestion of fish and/or invertebrates that may have accumulated PCBs from sediments and/or surface water of Indian Creek and Blue River. Assessment endpoints were expressed as follows:

Survival, growth and reproduction of semiaquatic invertebrate consumers – These consumers ingest invertebrates that are (at some stage in their lives) in intimate contact with sediments, and as a result, may have accumulated PCBs.

Survival growth and reproduction of semiaquatic carnivores – These organisms become increasingly important in terms of biomagnifying chemicals.

To develop a measurement by which the assessment endpoint may be tested, an applicable ecological component is identified that represents the assessment endpoint. For ingestion pathway exposures associated with higher vertebrates the generally accepted approach is to select indicator species (EPA 1997; 1998), referred to as *receptors of concern* (ROCs). ROCs are selected because toxicity reference values (TRVs) used for comparing environmental exposures to potential effects are species-specific. Insectivorous and carnivorous birds and mammals were identified as assessment endpoints. Insectivores will be exposed to PCBs since emergent aquatic insects, in their pre-emergent stages, are directly exposed to surface water and sediments. Because PCBs biomagnify, carnivorous birds and mammals, particularly piscivores (fish-eating) will be subject to the greatest PCB exposures. Among these groups, tree swallows and the little brown bats were selected to represent insectivorous birds and mammals because both of these species often feed on insects over water. In addition, because of their small size, both swallows and bats have high metabolic rates that may result in higher exposures due to high consumption relative to body weight.

Among carnivorous (specifically piscivorous) birds, the great blue heron and belted kingfisher were selected as ROCs. Both are resident to the area and are largely piscivorous. Being smaller than the heron, the kingfisher has a higher metabolic rate and will ingest a greater amount of food relative to its body weight. Among mammals, the mink was selected as a ROC. The mink also has a small body weight (and relatively high ingestion rate), and are also known to be sensitive to PCBs.

Ecological Risk Analysis

Risk analysis is the process by which the assessment points are evaluated. The process requires: (1) an exposure concentration; (2) measures of receptor characteristics, and (3) credible literature-based toxicological effect levels. The assessment endpoints selected for this ERA are based on ingestion pathway exposures. Inferences about the potential hazards of ingesting PCBs were based on the relationship between the environmental exposure concentration (EEC), and a *response*. The EEC for sediments and surface water was based on analytical data available for Indian Creek and Blue River. Though there is an abundance of fish tissue data, the majority is associated with fillets. Because PCBs are highly lipophilic, lipid ratios between wholebody and fillets were used to adjust the fillet data, since it is the wholebody concentration that is of interest in the ERA. Measured tissue concentrations were not available for aquatic invertebrates. Based on their biomagnifying properties, PCB concentrations are expected to increase at higher trophic levels. This was demonstrated using empirical data from other studies, in which benthic macroinvertebrate tissue PCB concentrations were less than those in fish. Benthic invertebrate tissue concentrations were then conservatively assumed to approximate wholebody fish tissue concentrations.

Measures of receptor characteristics are used in conjunction with the EECs to express ingestion pathway exposures as an average daily dose (ADD). These measures include food, water and sediment ingestion rates, body weight, diet composition, and area use. The calculated total PCBs obtained through the diet (food ingestion), and through direct ingestion of surface water and sediment, and normalized to the size of the study area relative to the area over which a ROC may forage (i.e., the area use) comprise the ADD, expressed in units of mg/kg-BW/day. Assumptions for the measures of receptor characteristics used in this ERA were based on formally-published information for the species, or plausible surrogate species. Where direct information was not available, generally-accepted principles and qualified-professional judgment were used to derive assumptions from relevant literature that could be representative of conditions in Indian Creek and Blue River.

Comparison of the ADD to a toxicity reference value (TRV) provides an indication of ecological risk. This approach is referred to as the hazard quotient method, and the ratio is termed the ecological effects quotient (EEQ). Several databases, in addition to the open literature, were consulted for compilation of TRVs for PCBs. These include the ECOlogical TOXicity database (ECOTOX); ASsessment Tools for the Evaluation of Risk (ASTER); the Hazardous Substances DataBase (HSDB); the Integrated Risk Information System (IRIS); the TOXicity NETwork (TOXNET, which includes MEDTECS); and the Registry of Toxic Effects of Chemicals (RTECS). U.S. Fish and Wildlife Service *Contaminant Hazard Series* synopses, RTI (1995), Oak Ridge National Laboratory technical reports (Sample *et al.* 1996), and available Agency for Toxic Substances and Disease Registry (ATSDR) *Toxicological Profiles*. These sources were used to provide the information necessary for selecting toxicity reference values (TRVs) to derive ecological effect concentrations and to more completely illustrate the nature of the potential toxicity associated with PCBs. Two TRVs were ultimately selected for each receptor from among the multiple values in the database: a Lowest-Observed-Adverse-Effect Level (LOAEL), and a No-Observed-Adverse-Effect Level (NOAEL). The LOAEL is the lowest dose that results in a statistically significant effect compared to a control. The NOAEL is the highest dose where there is no statistically significant difference from the control response. Endpoints considered were generally limited survival, reproduction, development, and/or growth for the ROCs, consistent with the assessment endpoints.

Ecological Risk Characterization

Ecological risk is ultimately estimated based on interpretation of the EEQ. Because two TRVs were identified, the process results in calculation of both an EEQ_{LOAEL} and an EEQ_{NOAEL}. The following general guidelines were used to interpret EEQs for each ROC: An EEQ_{NOAEL} less than 1.0 suggests risks are low, and there is no need for further investigation.

An EEQ_{NOAEL} greater than 1.0 and an EEQ_{LOAEL} less 1.0 suggests that there is a potential for risk. Whether the risk is "unacceptable", or if further information gathering and evaluation is warranted, depends upon the uncertainty associated with the estimate, and the inherent conservatism built into the EEQ derivation process.

An EEQ_{LOAEL} greater than 1.0 suggests an elevated potential for risk. The conservatism built into the EEQ derivation process also plays a role in interpretation. Additional information collection and evaluation may be warranted, or steps may be taken to initiate evaluation of remedial alternatives.

EEQ results for each of the ROCs are summarized in the following table.

ROC	NOAEL EEQ	LOAEL EEQ
Little Brown bat	0.7	0.2
Tree Swallow	0.2	0.1
Belted Kingfisher	0.4	0.3
Great blue heron	0.1	0.1
Mink	0.7	0.6

The EEQ_{NOAEL} for each of the ROCs is less than 1. It is therefore concluded that risks are low for all ROCs, there is no need for further investigation, and that no remedial actions are necessary with respect to ecological concerns.

The primary goal of a Baseline Risk Assessment (BRA) is to provide an assessment of the potential risks associated with current and future exposure to chemicals at a site in the absence of any remedial action. Further, the BRA characterizes the nature of the chemical releases from the site and evaluates potential pathways for human and ecological exposures. Evaluation of the chemical release data and potential risks are important factors in the development of remedial alternatives.

This BRA is presented in two sections. The first subsection (V.C.1) presents the Human Health Risks Assessment (HHRA). The second subsection (V.C.2) presents the Ecological Risk Assessment. The remainder of this introduction provides a site description, site history, and land use.

Site Description and Operations History

The Kansas City Plant (KCP) is located on a 136-acre parcel of a 300-acre Federal Complex within the city limits of Kansas City, Missouri about 13 miles south of the downtown area. The KCP lies near the intersection of Bannister Road and Troost Avenue in southwest Kansas City. Two streams border the plant: Indian Creek to the south which flows into the Blue River to the east. A flood control system consisting of a floodwall and levee protects the federal complex from periodic flooding along the streams.

Surface drainage from the southeast portion of the KCP drains to the new 002 Outfall located on Indian Creek. The old 002 Outfall was originally located on the "old" Indian Creek Channel. During construction of Bannister Road and the flood control levee (1970 – 1971), Indian Creek was rerouted and 002 Outfall was moved to its present location. A reinforced concrete box culvert was used to extend the sewer system to the new creek alignment and outfall location. The old channel between the two outfall locations and the box culvert, excluding the Abandoned Indian Creek Outfall (AICO), constitutes the 95th Terrace Site. The AICO area was remediated previously. The name, 95th Terrace, is derived from the road 95th Terrace that overlies the former channel and box culvert.

PCB-contamination in the 95th Terrace area is primarily the result of a 1969 Department 26 (D26) spill. D26 is located in the southeast corner of the Main Manufacturing Building (MMB) and made plastic products. PCBs were an integral part of the production process. The spill occurred when an expansion joint in the process piping failed and released approximately 1,500 gallons of PCB oil to an adjacent gravel area located south of the building. Approximately 900 gallons of PCB oil went into the storm sewer and discharged into the old creek channel via the old Indian Creek Outfall. The spill was reportedly cleaned up using hay and pitchforks. Despite this effort, residual PCBs remained in the creek bottom sediments. Shortly thereafter, Indian Creek was rerouted and PCB contaminated sediment was buried underneath the box culvert. The 1969 spill likely discharged PCBs through the entire section of Indian Creek where the box culvert is currently located. In 1972 another PCB spill occurred at D26. Approximately 1,100 gallons of PCBs were discharged to surface soils outside D26. Some of the PCB oils reached the storm sewer and discharged to Indian Creek via the newly installed box culvert. Again cleanup was performed using hay and pitchforks.

Since the initial hay and pitch fork cleanup efforts, a number of remedial activities have been performed in the vicinity of 95th Terrace. In 1984 six manholes in the 002 Storm Sewer system were modified to decrease the amount of PCBs entering the storm sewer system. The manholes are located on a north-south line centered on the Manufacturing Support Building (MSB), also known as Building 13. At each of these manholes, a flow diversion was installed to ease the removal of debris.

In 1987, PCB-containing heat transfer oil and PCB-contaminated piping were removed from the two heat transfer systems, one was responsible for the 95th Terrace spills. One year later in 1988, additional remedial action was performed on the 002 Storm Sewer System The system was cleaned, repaired, and relined with "Insituform". Part of the system had been relined with "Insituform" in 1985. Installing "Insituform" consists of installing a flexible plastic liner into the storm sewer which later hardens in the shape of the original pipe. The lining reduced the likelihood of PCBs entering the storm sewer system.

Also in 1988, 1600 tons of contaminated material under the 002 Outfall raceway (soil, sediments, and concrete) were removed. This was located at the current discharge to Indian Creek. The raceway runs approximately 90 feet from the 002 Outfall discharge to Indian Creek. These materials had become contaminated as a result of the 1972 spill. Clean fill was used to return the area to grade and a replacement concrete raceway from the outfall to Indian Creek was constructed.

A large PCB remedial project was undertaken in 1993 at AICO. Approximately 27,210 tons of PCB-contaminated material (9,000 mg/kg maximum concentration) were removed for off-site disposal. PCBs at this location were primarily the result of the 1969 spill at the old 002 Outfall. Clean fill was used to restore the area to grade. AICO differed from 95th Terrace in that PCBs, up to 30 mg/kg, were present in shallow soils. At 95th Terrace, PCB contaminated soils were first detected at least 5 feet below the ground surface.

Two interim measure soil removal projects were completed in 1995 and 1997 in the Plating Building area. The contaminated materials were found above the storm sewer laterals which feed into the 002 Outfall.

The 1984 manhole lining was the most effective of the remedial efforts reducing 002 Outfall discharge PCB concentrations from approximately 100 μg/L to between 1 and 10 μg/L (ORNL, 1999). Insituform lining of the storm sewer laterals in 1988 further reduced 002 Outfall PCB discharge to the current level of <1 μg/L. None of the other remedial efforts, including AICO, appear to have had an effect on 002 Outfall discharge PCB concentrations.

A visual inspection of the area of the 002 Outfall and Raceway area conduced in March 1999 identified significant deposition of sediment along the banks of Indian Creek in the area between the 002 Outfall and Indian Creek. No evidence of serious bank erosion was present in the area.

A complete description of current conditions and the nature and extent of contamination at the 95th Terrace area is included in Sections III.A through III.C.

Land Use

The Federal Complex is zoned for heavy industry. Most of the property adjoining the KCP is zoned for residential use, with isolated but growing commercial tracts along the west and south sides. The north and east sides of the KCP have been designated for public recreational use. Several residences are located north of the facility on an adjacent bluff. A former municipal landfill is also located northeast of the KCP.

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95% UCL	95 percent upper confidence level
ADD	Average Daily Dose (mg/kg/day)
AF	Absorption Factor
AICO	Abandoned Indian Creek Outfall
ASTER	Assessment Tools for the Evaluation of Risk
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	Area use factor (decimal fraction)
bgs	below ground surface
BRA	Baseline Risk Assessment
BRK	Blue River Kilometer
BSAF	Biota-sediment Accumulation Factor
BW	Body weight (kg)
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
C_{food}	Concentration of COPEC in food (mg/kg)
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
C_{sed}	Concentration of COPEC in sediment (mg/kg)
C_{water}	Concentration of COPEC in water (mg/L)
D26	Department 26
DOC	Dissolved organic carbon
ECOTOX	Ecological Toxicity Database
EEC	Environmental Exposure Concentration
EEQ	Ecological Effects Quotient
EPA	Environmental Protection Agency
EqP	Equilibrium partitioning
ERA	Ecological Risk Assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERT	Emergency Response Team
GC	Gas chromatograph
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HSDB	Hazardous Substances Data Bank
IF	Intake Factor
INK	Indian River Kilometer
IR_{food}	Ingestion rate of food (kg/day)
IR_{sed}	Ingestion rate of sediment in (kg/day)
IR_{water}	Ingestion rate of water in (L/day)
J (J)	Qualifier indicating “estimated data” value
KCP	Kansas City Plant
LD_{50}	Dose lethal to 50% of test organisms
Loael	Lowest Observed Adverse Effect Level

LOAEL	Lowest-Observed-Adverse-Effect Level
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MVUE	minimum variance unbiased estimate
NA	Not Available/Not Applicable
ND	Not (or non) detected
NOAEL	No Observed Adverse Effect Level
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated biphenyl(s)
QA/QC	Quality Assurance/Quality Control
R (R)	Qualifier indicating "rejected" data value
RAGS	Risk Assessment Guidance for Superfund
RFI	RCRA Facility Investigation
RL	Reporting Limit
RME	Reasonable Maximum Exposure
ROC	Receptor of Concern
RTECs	Registry of Toxic Effects of Chemicals
SCEM	Site Conceptual Exposure Model
SDEF	Standard Default Exposure Factors
SEAM	Superfund Exposure Assessment Manual
SVOC(s)	Semivolatile organic compound(s)
TDS	Total dissolved solids
TOC	Total Organic Carbon
TOXNET	Toxicity Network
TRV	Toxicity Reference Value
U (U)	Qualifier indicating "not detected" data value
UCL	Upper confidence level
URS	URS Group, Inc.
USFWS	United States Fish and Wildlife Service
WWTP	Wastewater Treatment Plant
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WWTP	Wastewater Treatment Plant 95% UCL 95 percent upper confidence level

Unitary Abbreviations

µg/kg	micrograms per kilograms
µg/L	micrograms per liter
cm	centimeter
cm/hr	centimeters/hour
cm^2	square centimeter
cm^2/day	square centimeters per day
d	day
g	gram
g/cm^3	grams per cubic centimeter
g/day	grams per day
hr	hour
hrs/day	hours per day
kg	kilogram
kg/kg-day	kilograms per kilogram per day
kg/mg	kilograms per milligram
km	kilometer
K_{oc}	organic carbon partitioning coefficient
K_{ow}	octanol-water partitioning coefficient
L	liter
L/day	liter/day
m	meter
mg	milligram
mg/cm^2	milligram per square centimeter
mg/day	milligrams per day
mg/kg	milligrams per kilograms
mg/kg/day	
mg/kgBW/day	milligrams per kilogram body weight per day
mg/kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
n	number
pH	negative logarithm of the hydrogen ion concentration
ppb	parts per billion, equivalent to ug/kg or ug/L
ppm	parts per million, equivalent to mg/kg or mg/L
yr or y	year

V.C.1 HUMAN HEALTH RISK ASSESSMENT

V.C.1.1 Identification of Chemicals of Potential Concern

The purpose of this section is to identify chemicals of potential concern (COPCs). COPCs are defined as those potentially toxic chemicals which may have been released to the environment in significant quantities as a result of site-related activities.

As discussed in the introduction, PCBs associated with past spills are the COPCs for this risk assessment. While site history indicates that the primary form of PCB released from the KCP facility was Aroclor 1242, small amounts of the more highly chlorinated Aroclor 1260 were also handled throughout the KCP. The term "Aroclor" refers to a mixture of individual PCB congeners, not a specific chemical. The difference between Aroclor 1242 and 1260 relates to the relative proportion of various PCB congeners present. Aroclor 1260 has a higher proportion of highly chlorinated congeners than 1242. The numbering system used to identify individual PCB mixtures refers to the number of carbon atoms present and the degree of chlorination. For example, Aroclor 1260 refers to a mixture of 12-carbon compounds (biphenyls), with the overall mixture containing 60 percent chlorine by weight. Aroclor 1242 and 1260, as well as Aroclor 1254, have been detected in various environmental media at the KCP. Given that the only difference between the various Aroclor mixtures is the relative proportions of individual congeners, and that factors such as mixing, volatilization, and environmental degradation may influence these ratios, the reported detection of various forms of Aroclor is not surprising.

Aroclors 1016, 1060, 1221, and 1232 were not detected in any of the media analyzed for this site. Therefore, these compounds were not considered to be COPCs for this risk assessment.

V.C.1.1.1 Data Set

All previous data (soil, sediment, surface water, and fish) collected for the 95th Terrace Site (including data associated with Stormwater 002 Outfall [002 Outfall], Indian Creek and blue River) were used in the risk assessment. However, data from soils and other environmental media, which have been remediated, were not included in the HHRA.

Sampling locations for the data sets are provided in Section III.A and in the following figures:

- Deep soils: Figure 3.12 and 3.18
- Sediment/Surface Water: Figure3.12 and 3.13.
- Shallow soils: Figure 3.12 and 3.18

Fish data and sampling locations are discussed in detail in "Habitat, Water Quality, and Aquatic community Assessment of Indian Creek and Blue River at the U.S. Department of Energy's Kansas City Plant" (ORNL 2000a).

V.C.1.1.2 Data Usability

Prior to use in the HHRA, all site data were validated and qualified following the Quality Assurance/Quality Control (QA/QC) procedures described in the 95th Terrace Work Plan (DOE 1996). The quality assurance review was performed in compliance with EPA laboratory data validation guidelines (EPA 1994a, 1994b). Data of insufficient quality based on QA/QC criteria were rejected at this point and not used in the HHRA. Sample results were assigned appropriate qualifiers at this stage (e.g., **J**-estimated).

Data were considered usable for risk assessment purposes if the data were unqualified or were estimated ("**J**" qualifier). Additionally, samples collected for QA/QC purposes (e.g., matrix spike/matrix spike duplicate) were not used in the HHRA. Representativeness is the degree to which data accurately and precisely represent a characteristic of population, parameter variations at a sampling point or an environment condition. Based on the identified sampling locations, the reporting limits, and repeated sampling of the investigation area, the data set was considered to be representative of the site.

V.C.1.2 Exposure Assessment

V.C.1.2.1 Identification of Potential Receptor Populations

Potential receptor populations are humans that may be impacted by site-related chemicals, either under current use conditions or under some hypothetical future use scenario. At the present time, PCB-contamination associated with the 002 Outfall Sewer System is primarily found in deep subsurface soils (>10 feet). Excavation into these deep soils could result in exposure of workers to contaminated soil and groundwater. However, this type of exposure is unlikely since most contamination is relatively deep, and occurs beneath a major trafficway (Bannister Road) and other traffic improvements (95th Terrace, KCP parking areas), which preclude most excavation activities by the nearby flood control works. More shallow soils (0-10 feet) contain scattered contamination of PCBs. Except for a few scattered soils along the creek, these soils are predominantly covered by parking lots and vegetation and are not readily accessible. Occupational workers, such as utility maintenance workers, could be exposed to these soils when doing utility work. Minor releases to surface water also occur from a seep located in a joint of the box culvert for 002 Outfall, potentially resulting in exposure to receptors in Indian Creek (i.e., recreational receptors).

Five exposure scenarios have been evaluated quantitatively in this HHRA. They are presented below.

Excavation Workers: This scenario is defined as workers who are involved in excavation of deep soils (>10 feet) underneath 95th Terrace and Bannister Road. The probability of this type of exposure occurring is very low due to the depth of the excavation that would be required to come into contact with the contamination, plus the fact that Bannister Road is a major thoroughfare in this portion of Kansas City, and 95th Terrace is a major access road for the KCP. Therefore, any excavation would be highly disruptive to local traffic.

Utility Maintenance Worker (Utility Worker): This receptor population is defined for the HHRA as a worker population that would be on site for a limited period of time to perform maintenance activities on buried utilities. This receptor would be exposed to shallow soils (0-10 feet bgs) related to the 95th Terrace site. The probability of this type of exposure occurring is much greater than for the excavation worker described above. This population includes both current and hypothetical future workers.

Construction Workers: This scenario is intended to address workers who could be involved in work on the culvert or along the creek, and would thus be exposed to both contaminated sediments in the creek and along the bank, and surface water. The probability of this type of exposure occurring is substantially greater than for a worker performing deep excavation work beneath 95th Terrace and Bannister Road.

Excavation worker, utility worker, and construction worker scenarios were developed as separate scenarios to address the different types of worker exposure that could occur at the site. In particular, these scenarios were developed to address exposure to deep soils underlying 95th Terrace (excavation worker), shallow soils at 95th Terrace (utility worker), and sediments and surface water in Indian Creek and at the 002 outfall (construction worker). The probability that a worker could be exposed to shallow soils, sediments and surface water was considered to be much greater than for deep soils since these media are more readily accessible and activities such as maintenance of utilities and the culvert occur only occasionally. Exposure to deep soils underlying 95th Terrace and Bannister Road was considered an improbable scenario, but was evaluated in the HHRA in order to evaluate potential risks should such an activity occur. The improbability of deep soil exposure is supported by the following: 1) While the depth of contamination (30-40 feet bgs) does not preclude excavation, the likelihood of excavation work to that depth is low, given that utilities and other typical subsurface structures are usually placed at much shallower depths, 2) Bannister Road is a major thoroughfare in this portion of Kansas City, and 95th Terrace is a major access road for KCP, and any major excavation under these roads would disrupt local traffic, and 3) Excavation to the depth of contamination could compromise the integrity of the flood wall that protects the Kansas City Plant. Utility workers and construction workers were evaluated as separate receptor populations because the site covers a large surface area and breaking the site into smaller sections helps to focus the evaluation on potential problem areas.

Another receptor population which would be protected by the construction worker scenario is the emergency services worker (i.e., first responders, firemen, etc.). This population could potentially be exposed to sediments and surface water associated with 002 Outfall and Indian Creek when responding to an emergency in the area. However, their exposure period is expected to be significantly less (a few hours per incident and less than one incident per year) than that considered for the construction worker.

Recreational Receptor (Adult): For the purpose of the HHRA, this term refers to any adult receptor population that visits Indian Creek on a regular basis. This population would include primarily recreational fishermen. This receptor would be exposed to sediment and surface water associated with the 002 Outfall and Indian Creek. Based on evidence from a site reconnaissance in June 2000, this receptor could also be exposed to contaminants in fish caught in Indian Creek or downstream in the Blue River. This population includes only current recreational receptors because the 002 Outfall is still active.

Recreational Receptor (Child): For the purpose of the HHRA, this term refers to any child receptor population (aged 6-15 years) that visits Indian Creek on a regular basis. This population would include waders and recreational fishermen. This receptor would be exposed to sediment and surface water associated with the 002 Outfall and Indian Creek. Based on evidence from a site reconnaissance, this receptor could also be exposed to contaminants in fish caught in Indian Creek or downstream in the Blue River. This population includes only current recreational receptors because the 002 Outfall is still active.

V.C.1.2.2 Evaluation of Potential Exposure Pathways

An exposure pathway is a mechanism by which a receptor may come into contact with a chemical. Information on waste sources, waste release and transport mechanisms, receptor populations and exposure point locations are used to identify potentially complete exposure pathways. As defined by RAGS (EPA 1989), an exposure pathway includes four major elements. These elements are:

- A source of chemicals and mechanism of chemical release
- A transport medium (soil, surface water, etc.)
- A point of potential receptor contact with the medium (i.e., an exposure point)
- A route of exposure (e.g., ingestion, dermal contact, inhalation) for the receptor to come into contact with the chemical

For an exposure pathway to be complete, all four elements must be present. The absence of any one of these elements results in an incomplete exposure pathway for which site-related health risks do not exist. Thus, the evaluation of potential exposure pathways is necessary to focus on only those pathways which are complete and could potentially impact human health.

To develop a conceptual understanding of the site and the potential to impact human health and environment, a site conceptual exposure model (SCEM) was used to identify plausible exposure scenarios. Figure 5.1 presents the SCEM for the 95th Terrace Site and 002 Outfall. Solid lines designate complete exposure pathways while incomplete pathways are shown with dotted lines. As demonstrated in this diagram, the primary sources of contamination at the site at the present time are the soils and sediments underlying the box culvert for 002 Outfall. Based on known site history, the PCBs in these soils/sediments were thought to have originated from two spills that occurred prior to the re-routing of Indian Creek. Although cleanup occurred at the time of the spills, some amount of PCBs remained in sediments after the spills, and these contaminated sediments were subsequently covered with fill material during the re-routing of Indian Creek and the construction of 95th Terrace and the new 002 Outfall Sewer System.

Two primary release mechanisms were identified in the SCEM: (1) potentially significant release of PCBs from deep soil/sediment at the 95^{th} Terrace Site during excavation activities and (2) PCBs released through the 002 Outfall. Additionally, PCBs entrained on soil particles into surface water via a seep in the box culvert represent a minor release.

Based on the pathway analysis presented in the SCEM, the media of potential concern include deep soils, shallow soils, sediments, surface water and fish. For the receptors listed above, exposure of potential receptors to contaminated media may occur by two intake routes: ingestion (directly or via food chain) and dermal absorption. Presented below is a discussion of potentially complete exposure routes for the media of potential concern at the 95^{th} Terrace Site and 002 Outfall.

Exposure to contaminated soil. At the current time, virtually all the soils associated with this site are beneath paved roadways or in areas where significant exposure is unlikely to occur. Therefore, excavation workers and utility workers are the only identified human receptor populations potentially exposed to this media.

In the event that excavation activities or utility maintenance/repair were to occur, workers could be exposed to PCB-contaminated soil by incidental ingestion and direct dermal contact. Inhalation is not likely to be a significant exposure route because PCBs are non-volatile compounds and the deep soils are located in the saturated zone. Additionally, utility work generally does not involve a large enough area to generate significant particulate matter via wind erosion. Therefore, volatile emissions and particulate emissions would not be generated for exposure.

Exposure to contaminated surface water. Minor releases to surface water have occurred from a seep located in a joint of the box culvert and runoff from the KCP, potentially resulting in exposure to receptors in Indian Creek. Potential receptors in the creek included construction workers who might have to repair the outlet and recreational receptors (both adult and child).

Potentially complete exposure routes to PCB-contaminated surface water in Indian Creek include dermal contact by current recreational users (i.e., children playing at the creek, fishermen, etc.) and incidental ingestion by current recreational users. Consumption of aquatic organisms from the creek by current recreational users was also considered to be a complete pathway. Construction workers could also be exposed to surface water if the outlet requires repair or if other construction activities are necessary (i.e., road work, utility repair, etc.). Construction workers could be exposed via the dermal contact and incidental ingestion pathways.

Exposure to contaminated sediments. Sediments were considered impacted by the PCB-contaminated surface water in Indian Creek. Therefore, sediments represent a media of potential concern. Potentially complete exposure routes include dermal contact by current recreational users and incidental ingestion by current recreational users. As with surface water, construction workers could be exposed to sediments during work-related activities via the dermal contact and incidental ingestion pathways.

Exposure to contaminated fish. PCBs are known to be highly bio-accumulated in fish tissue from PCB contaminated areas. Fish living in the creek could become contaminated due to the presence of PCBs in the surface water and sediments. Therefore, ingestion of fish from the creek by current recreational users (both adult and child) was considered to be a complete exposure pathway.

Exposure to groundwater. This pathway was considered incomplete for several reasons. First, PCBs have a very low solubility; thus only small concentrations of these compounds would dissolve in groundwater and be transported away from the site. Second, groundwater flow in the area is extremely slow. Therefore, any dissolved PCBs would not be transported to exposure points on a regular basis. Third, the soil pore size in the KCP area is very small, the predominant soil type is clay. The small pore size limits the mobility of large molecular compounds such as PCBs. Only molecules which can readily fit into the small clay soil pores would be rapidly transported with the groundwater as it moves across the site. Finally, the contributing area of contamination is small, basically limited to the width of the 002 Outfall Sewer System. Based on these physical characteristics of the area, groundwater was considered to be an incomplete pathway and was not evaluated in the risk assessment. A detailed discussion of site groundwater migration is provided in Section III.A.1.

It is important to note that the only complete exposure pathways identified for Indian Creek are for current receptors. The 002 Outfall is an active outlet; therefore, future risks cannot be quantified.

In summary, potentially complete and significant human exposure pathways are:

Excavation Workers

- Incidental ingestion of deep soils (95th Terrace Site)
- Dermal contact with deep soils (95th Terrace Site)

Utility Worker

- Incidental ingestion of shallow soils (95th Terrace)
- Dermal contact with shallow soils (95th Terrace)

Construction Workers

- Incidental ingestion of surface water (Box Culvert/002 Outfall/Indian Creek)
- Dermal contact with surface water(Box Culvert/002 Outfall/Indian Creek)
- Incidental ingestion of sediments (Box Culvert/002 Outfall/Indian Creek)
- Dermal contact with sediments (Box Culvert/002 Outfall/Indian Creek)

Recreational Receptors (Adult)

- Dermal contact with sediments (002 Outfall/Indian Creek)
- Incidental ingestion of sediments (002 Outfall/Indian Creek)
- Dermal contact with surface water (002 Outfall/Indian Creek)
- Incidental ingestion of surface water (002 Outfall/Indian Creek)
- Ingestion of harvested fish (002 Outfall/Indian Creek)

Recreational Receptors (Child)

- Dermal contact with sediments (002 Outfall/Indian Creek)
- Incidental ingestion of sediments (002 Outfall/Indian Creek)
- Dermal contact with surface water (002 Outfall/Indian Creek)
- Incidental ingestion of surface water at (002 Outfall/Indian Creek)
- Ingestion of harvested fish (002 Outfall/Indian Creek)

V.C.1.2.3 *Receptor Populations Not Evaluated*

One goal of the HHRA is to protect all populations reasonably expected to come into contact with site contaminants. To achieve this goal, the HHRA evaluates the most-exposed populations. The results of this "worst case analysis" would also be protective for populations with less exposure. Because of this, certain potential receptor populations that may be present at the site were excluded from the quantitative evaluation if exposures are likely to be minor. Examples of such populations and the basis for exclusion are listed below:

- **Residential populations.** While it is not feasible for a resident to build a home on the 95th Terrace Site or in the Indian Creek, local residents are the most likely population to visit Indian Creek for recreational purposes. The recreational receptor has been designed to be protective of the types of exposures most likely to occur for residents in the area.
- **Transient receptor.** These receptors may include drivers of cars, etc. on 95th Terrace or individuals walking along the road. Because the contamination is confined to subsurface soils, these populations would not be exposed.
- **Sensitive population.** Sensitive populations include the elderly or infirm in hospitals or care facilities, children in daycare centers, etc. These types of populations do not exist in the immediate vicinity of the site.

V.C.1.3 Exposure Assumptions

V.C.1.3.1 Evaluation of Exposure Assumptions

In order to calculate cancer risks and noncancer hazards associated with exposure to the COPCs, it is first necessary to estimate the amount of chemical taken into the body on a chronic basis via the various exposure routes. This estimate, termed the chronic daily intake (CDI), is calculated using a series of exposure parameters derived from a variety of sources. A full discussion of these equations is provided in this section. Parameters, which are typically quantified, include the following:

- Life span (years)
- Exposure duration (years)
- Exposure frequency (days/year)
- Exposure time (hours/day)
- Soil ingestion rate (mg/day)
- Body weight (kg)
- Exposed skin surface area (cm^2)
- Dermal soil adherence (mg/cm^2)
- Dermal soil absorption factor (unitless)
- Water ingestion rate (L/day)
- Fish ingestion rate (g/day)
- Permeability constant (cm/hour)

These parameters are assigned numerical values (Tables 5.1 through 5.16) which are used to estimate the magnitude of chemical intake. The numerical values used in the exposure equations have been developed using site-specific information and professional judgment, supplemented by a number of EPA reference sources. EPA guidance used when developing exposure assumptions include the Exposure Factors Handbook (EPA 1997a), OSWER Directive 9285.6-03 (Standard Default Exposure Factors; EPA 1991a), Dermal Exposure Assessment: Principles and Applications (EPA 1992a), and RAGS (EPA 1989). Conservative exposure assumptions are used so that potential exposures and potential health risks are not underestimated.

Life Span

As recommended by EPA (1997a), life span is assumed to be the same for all populations, and is given as 75 years.

Averaging Time

Averaging time for noncarcinogenic effects was based on the exposure duration (EPA 1989). Averaging time for **excavation, utility and construction workers** for noncarcinogenic effects was 21 days for the central tendency scenario and 42 days for the RME scenario. This assumed an exposure duration of 1 year multiplied by 21days/year (21 days or 3 full weeks) in the central tendency case and an exposure duration of 1 year multiplied by 42 days/year (42 days or 6 full weeks) in the RME case. This is more conservative than averaging over 365 days/year, because the 21 and 42 day/year exposure is more realistic. Averaging by 365 days/year could dilute a potential hazard to a level that would be considered safe.

Recreational receptors are assumed to be local residents who fish in the creek. **Adult recreational receptor** central tendency and RME averaging time for noncarcinogenic effects was 9 years (3,285 days) and 30 years (10,950 days), respectively. **Child recreational receptor** central tendency and RME averaging time for noncarcinogenic effects was 9 years (3,285 days).

Averaging time for carcinogenic effects was 75 years (27,375 days) in both the central tendency and RME cases for all receptors (EPA 1997a).

Exposure Duration

Exposure duration refers to the number of years in which exposure occurs to contaminated media. **Adult recreational receptors** were assumed to have a central tendency exposure duration of 9 years (50th percentile duration of residence in a single location, EPA 1997a). The adult recreational receptor RME value is assumed to be 30 years in the RME case (EPA 1997a). This is the 90th percentile duration of residence in a single location (EPA 1997a). For **excavation and construction workers**, a one-year duration was assumed for both the RME and central tendency exposure, based on the assumption that excavation/construction activities would occur on a one-time basis and would be completed within one year. The **child recreational receptors** were assumed to have an exposure duration of 9 years (ages 6-15). The age range of 6-15 years was selected because this age of child is most likely to venture out on his or her own..

Exposure Frequency

Exposure frequency refers to the number of days per year spent in direct contact with site contaminants. **Adult and child recreational receptors** are assumed to visit the site two times per week for 26 weeks in the RME case (52 days per year), and once per week for 26 weeks for the central tendency scenario (26 days per year). The values account for inclimate weather during one-half of the year. These exposure frequencies are probably conservative, based on evidence from a site reconnaissance conducted on June 6, 2000. No footpaths were visible from the residences above Indian Creek down to the creek itself. Also, no evidence of regular human activity were observed along the Indian Creek near the Outfall. This suggests that foot traffic in the area is light and that visits to the creek by potential recreational receptors do not occur on a daily basis. **Excavation, utility and construction workers** are assumed to perform intrusive activities in contaminated areas for a total of 30 days (5 days per week for 6 weeks) in the RME case. Central tendency worker exposure is assumed to be half of the RME rate (15 days total). For ingestion of fish, **recreational receptors (adult and child)**, the exposure frequency is assumed to be 365 days/year. This value is used because the intake rate is based on the number of grams of fish ingested on a daily basis in a year's time.

Exposure Time

Exposure time refers to the number of hours per day that a receptor is in direct dermal contact with potentially contaminated media. Populations potentially exposed to these media include workers and recreational receptors. For soils and sediment, **excavation, utility and construction workers** were assumed to be exposed 8 hours per day for the RME and central tendency scenarios, based on a full working day. For construction workers, surface water exposure time was assumed to be 4 hours/day for both the central tendency and RME scenarios, based on one-half the normal working day. **Recreational receptors (adult and child)** were assumed exposed for 4 hours/day in the RME case and 2 hours for central tendency.

Soil/Sediment Ingestion Rate

The soil/sediment ingestion rate refers to the amount of soil or sediment that is ingested daily. For **excavation/construction/utility workers and adult recreational receptors**, the RME ingestion rate is 100 mg/day and the central tendency is 50 mg/day. The RME value is the standard default exposure factor (SDEF) for agricultural workers (EPA 1991a). It is also the upper end of the adult range of 1 to 100 mg/day reported by Calabrese (1987). The rate of 50 mg/day is the value recommended by the EPA as a reasonable central estimate of adult soil ingestion (EPA 1997a). For **child recreational receptors**, soil/sediment ingestion rates are assumed to be 100 mg/day and 200 mg/day in the central tendency and RME case, respectively. The values are the recommended SDEFs (EPA 1991a).

The soil/sediment ingestion rate used in the HHRA (100 mg/day) differs from the EPA recommended rate of 480 mg/day identified in 1997 EFH. The 480 mg/day ingestion is based on an observational study by Hawley (1985). The Hawley study estimated soil ingestion for a contact intensive scenario based on assumptions of the soil adherence rate to the skin, assuming that all the soil adhering to a portion of the skin was ingested. The assumed soil adherence rate used in the Hawley study was 3.5 mg/cm^2. New data from EPA-sponsored studies reported by Kissel et al. (1996) show that even for contact intensive activities, adherence of soil to hands is substantially less than 1 mg/cm^2. For example, measured dermal adherence of soil to hands while farming was an average of 0.44 mg/cm^2, and was even lower for other parts of the body exposed during work. EPA's EFH (1997) recommends using the Kissel data to estimate soil adherence to skin. Following this recommendation, a soil ingestion value of 60 mg/day can be estimated by adjusting the Hawley data using the experimentally determined dermal adherence factor for farmers hands of 0.44 mg/cm^2 (480 mg/day x 0.44/3.5 = 60 mg/day). This value is higher than the high-end soil ingestion estimate of 50 mg/day recommended by EPA for adults in the typical occupational setting or industrial workplace. The HHRA value of 100 mg/day RME soil ingestion among excavation, utility and construction workers, is still a conservative estimate of soil ingestion. The CT value of 50 mg/day was based on the assumption that the average worker would not have the same degree of soil contact as the worker with upperbound exposure.

Body Weight

The body weight for adults recommended by EPA is 71.8 kg (EPA 1997a). This value is used to evaluate both the RME and central tendency exposures for **excavation/construction/utility workers and adult recreational receptors**. The body weight for **child recreational receptors** is 45.3 kg for both the central tendency and RME scenarios. The body weight is the mean body weight for boys and girls, aged 12 years (EPA 1997a).

Skin Surface Area

Exposed skin surface area is important when evaluating uptake of chemicals that are absorbed dermally. For the **excavation/construction/utility worker**, the RME value of 5,230 cm^2 is based on the combined surface areas of the head, hands, forearms, and lower legs (EPA 1997a). The RME value is conservative because it does not account for normal clothing worn during cool weather. The central tendency value of 3,160 cm^2 is equivalent to the head, forearms, and hands (EPA 1997a). For **adult recreational receptors**, the RME value is 7,780 cm^2/day, which is equivalent to the head, arms, hands, lower legs, and feet. The central tendency value is 4,050 cm^2/day, which is equivalent to the hands, forearms, and lower legs (EPA 1997a). For **child recreational receptors**, the RME value is 7,780 cm^2, which is equivalent to the head, arms, hands, lower legs, and feet. The central tendency value is 4,050 cm^2/day, which is equivalent to hands, forearms, and lower legs (EPA 1997a). The adult recreational receptor surface area values were used for the child receptor due to an uncertainty indicated in EPA (1997a) regarding estimation of surface area for children older than 13 years of age.

Dermal Soil Adherence

Dermal soil adherence is used, in conjunction with exposed skin surface area, to define the total amount of soil adhering to exposed skin surfaces. EPA recommends a range of 0.2 mg/cm^2 to1.0 mg/cm^2 as the dermal soil adherence for dermal exposure to soil (EPA 1992a). The RME value is the upper end of the range. The central tendency value is the lower end of the range.

Dermal Absorption Factor

The dermal absorption factor provides an estimate of potential chemical absorption through the skin. For this HHRA a dermal absorption of 14 percent was selected for the RME scenario and 7 percent for the central tendency scenario. The 14% dermal absorption value is presented in EPA's *2000 PCB Risk Assessment Review Guidance Document* (EPA 2000b) and is based on a study by Wester et al. (1993) in which PCB absorption was studied in rhesus monkeys. The study protocol involved shaving the hair, applying a PCB mixture, and covering the application to prevent any loss of material over an 8-hour time span. This type of high contact scenario is likely to overestimate absorption under more realistic conditions. It is important also to note that the Wester study has not been independently verified, suggesting that these results are still tentative. A more recent study by Qiao and Riviere (2000) studied absorption and penetration of 14C-tetrachlorobiphenyl in a soil-based mixture. The findings of this study showed absorption over an 8-hour period at 0.66%, and penetration at 2.48%. Taken in combination, the results of these studies indicate that 14% is an overly conservative estimate for evaluating CT exposure, and may overestimates RME as well. Therefore, the value of 7% was selected for the CT exposure.

Surface Water Ingestion Rate

Surface water ingestion rates were estimated based on swimming events. EPA (1988) states that a swimmer ingests approximately 50 ml of water per swimming event (1.0 hour /event, 1 event /day). The RME value for this risk assessment was one-fifth the incidental water ingestion rate while swimming (10 ml/day). The central tendency value is one-half the RME value (5 ml/day). **Construction workers** were assumed exposed to surface water in the 002 Outfall Sewer System and Indian Creek. Ingestion of water was assumed to be from splattering, and that only incidental ingestion of water would occur. **Recreational receptors** were all assumed to come into contact with the surface water in Indian Creek and the Indian Creek – Blue River confluence.

Fish Ingestion Rate

Uptake of contaminants via ingestion of fish caught in Indian Creek is a function of the mass of fish ingested per day, the fraction of ingested fish that is from the contaminated area, and the bio-availability and bio-concentration properties of the contaminant. Recreational receptors were the only populations assumed to ingest the fish from Indian Creek. **Adult recreational receptors** are assumed to ingest 16 g/day in the central tendency scenario and 45.2 g/day in the RME scenario. The values are the mean and 95th percentile estimates of total fish consumption by African-Americans as shown in EPA (1997a, Table 10-1). This population was considered to be most representative of the recreational fishermen in Indian Creek based on the site June 2000 reconnaissance and area demographics. Two species of fish are most common within the project area: channel catfish and green sunfish. For the risk assessment, recreational receptors were considered to consume both species of fish. Therefore, one-half (8 grams/day and 22.6 grams/day) the EPA recommended values (listed above) were used to calculate the intake factor for fish consumption. This approach was used to avoid calculating a risk based on twice the selected fish consumption rate. **Child recreational receptor** fish ingestion values are one-half the adult recreational receptor values (8 g/day – average, 23 g/day – RME). As with the adult receptor, the intake factor was calculated using one-half of the total grams (4 g/day and 11.5 g/day) consumed, to account for the two species of fish.

The fraction ingested is 0.25 in the RME case and 0.1 in the central tendency case. The central tendency value assumes 10 percent of the fish ingested by the recreational receptor has been impacted by the site. The RME values assume that 25 percent of the fish ingested by the receptor has been impacted by the site. This is a conservative approach because Indian Creek does not have great enough flow to support a large fish population. Additionally, no footpaths or other evidence of regular human activity were observed along the creek in the vicinity of the Outfall during the site reconnaissance on June 6, 2000. In fact, the heavy underbrush and lack of parking or other forms of access undoubtedly hinder anyone from fishing in this area. Therefore, the receptor likely fishes at other areas within the city and ingests fish from other sources.

Permeability Constant

Permeability constants are chemical-specific values used to define the dermal uptake of chemicals from aqueous media, and are presented in units of cm/hour. The permeability constant used in this HHRA was based on developing EPA guidance (EPA 1998). The document states that existing models for assessing exposure via dermal exposure to surface water are not accurate for many of the higher molecular weight (MW) compounds; including PCBs (EPA 1998). EPA's proposed methodology was used for quantifying potential exposures in this HHRA. This methodology involves determining the theoretical maximum permeability coefficient for water. Values were provided for PCB 4-chlorobiphenyl (0.77 cm/hour) and for PCB hexachlorobiphenyl is (0.44 cm/hour). The Aroclors most prevalent at the 002 Outfall site are predominantly tetrachlorobiphenyls (Aroclor 1248) and pentachlorobiphenyls. The applicable permeability constant is likely between that of 4-chlorobiphenyl and hexachlorobiphenyl. Therefore, the more conservative value of 0.77 cm/hour was used for estimating exposures at the 002 Outfall site.

Matrix Effect

Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption. For this risk assessment, a matrix effect of 1 was assumed for the RME exposure scenario. For the central tendency evaluation, 0.5 (50 percent) was used as the matrix effect.

V.C.1.3.2 Estimation of Exposure Point Concentrations

Exposure point concentrations are the chemical concentrations to which a receptor is exposed when contact is made with a specific environmental medium. Where applicable, exposure point concentrations have been calculated separately for each contaminated media (deep soil [>10 feet below ground surface], shallow soils [0-10 feet below ground surface] sediment, surface water, and fish).

The concentrations shown in Table 5.17 are the exposure point concentrations for deep soils, shallow soils, sediments, surface water, and fish in this HHRA. The approach used to calculate exposure point concentrations of the COPCs is that recommended by EPA (1992c), and is based on statistical averaging of all sample data from a site using the "H" statistic approach. This approach assumes that the same exposure point concentration is used to evaluate both the RME and central tendency exposure. In locations where the chemical was reported as undetected, the chemical is assumed to be present at one-half of the detection limit, in accordance with EPA (1989). From this information, a 95 percent upper confidence limit (UCL) on the arithmetic mean was calculated. The concentration associated with the 95 percent UCL or the maximum concentration detected, whichever was lower, was adopted as the exposure point concentration for each chemical. Use of the maximum concentration, if less than the upper-bound, is supported by EPA (1989). This approach is supported by the observation that the 95 percent UCL concentration may exceed the maximum reported concentration in instances where the variation of the data is large or when high detection limits (above concentrations detected) strongly influence calculation of 95 percent UCL values. The 95 percent UCL of lognormally distributed data was calculated using the following equation:

$$UCL = e^{(\bar{x} + 0.5S^2 + sH/\sqrt{n-1})}$$

where:

UCL	=	Upper confidence limit
e	=	Constant (base of the natural log, equal to 2.718)
$\bar{x}$	=	Mean of the log transformed data
s	=	Standard deviation of the log transformed data
H	=	H-statistic (e.g., from table published in Gilbert 1987)
n	=	Number of samples

Data sets with fewer than 10 samples do not provide an adequate basis for the calculation of the 95% UCL. Therefore, in this risk assessment, all data sets with fewer than 10 samples used the maximum detected concentration as the RME. Tables 5.18 through 5.27 show the calculation of the exposure point concentrations for deep soils, shallow soils, sediments, surface water, and fish. Note: The sediment and surface water data sets for construction workers and recreational receptors are different. This is because recreational exposures would be limited to contact with surface water and sediment outside the 002 Outfall Sewer System. Construction workers were assumed contact sediments and surface water both inside and outside the system during the course of their activities.

Total PCB concentrations were not analyzed for in sediments, surface water, and some soil samples. For these samples, total PCB concentrations were estimated by adding one-half the reporting limit for the individual mixtures if they were not detected and/or the actual detected concentrations for each individual mixture. See Tables 5.19 through 5.27.

V.C.1.3.3 Estimation of Chemical Intakes

Using the exposure point concentrations of COPCs in soil, sediment, surface water, and biota, it is possible to estimate the potential human intake of those chemicals via each exposure pathway.

Intakes are expressed in terms of mg chemical per kg body weight per day (mg/kg-day). Intakes were calculated following guidance in Risk Assessment Guidance for Superfund (EPA 1989), Exposure Factors Handbook (EPA 1997a), other EPA guidance documents as appropriate, and professional judgment regarding probable site-specific exposure conditions. Intakes were estimated using reasonable estimates of body size, ingestion rates, dermal absorption rates, soil matrix effects, and frequency and duration of exposure. These parameters are discussed in Section V.C.1.3.

Intakes were estimated for both central tendency and RME conditions. Central tendency exposure is the exposure that, applying EPA guidance and professional judgment, represents the typical or most likely exposure for an individual with normal activity patterns. The central tendency (or most likely) exposure scenarios are conservative (i.e., protective of most receptors) in that they assume that contact with contaminated media occurs routinely over the course of many years (when in fact such assumptions may never be realized). The RME was estimated by selecting values for exposure variables so that the combination of all variables results in the maximum (high-end) exposure that can reasonably be expected to occur at the site. In this risk assessment, the RME scenarios were developed using EPA's Standard Default Exposure Factors (SDEFs) (EPA 1991a) where available. Otherwise, professional judgment was used to estimate site-specific exposure parameters. These factors probably significantly overestimate actual exposures at the sites.

The general equation for calculating intake in terms of mg/(kg-day) is:

$$Intake = \frac{chemical\ conc. * contact\ rate * exposure\ frequency * exposure\ duration}{body\ weight * averaging\ time}$$

The variable "averaging time" is expressed in days to calculate average daily intake. The averaging time approach used in this risk assessment followed standard human health risk assessment protocols, and is based on the difference in mechanisms of action of cancer and non-cancer effects. The cancer averaging time assumes that carcinogens can have a potential effect, no matter how small the dose. Therefore, intakes were calculated using a 70-year lifetime exposure. The non-cancer averaging dose (i.e., there is a dose level below which no adverse effects will occur). The non-cancer averaging time also assumes that no adverse effects would occur once exposure has ended. Therefore, non-cancer averaging times were calculated using the assumed exposure duration for average and RME exposures.

Omitting chemical concentrations from the intake equation yields a pathway-specific "intake factor" (Kg soil, L water, and M^3 air kg-day). Since the exposure pattern resulting in exposure to various COPCs is the same, the pathway-specific intake of a chemical can be calculated by multiplying the concentration of each chemical by the intake factor (IF). IFs were calculated separately for each receptor and exposure pathway. The IFs used in the HHRA are presented in Table 5.28. The assumptions used in deriving IFs were discussed in Section V.C.1.3 and are presented in Tables 5.1 through 5.16.

V.C.1.4 Toxicity Assessment

Detailed toxicity profiles, which describe the chemical-specific toxic effects of PCBs, are presented in Attachment 1. The following text describes the methods used by EPA to evaluate carcinogenic and noncarcinogenic effects related to exposure to these compounds.

V.C.1.4.1 RfDs for Noncarcinogenic Effects

Substances that produce adverse noncarcinogenic effects are generally thought to have a threshold dose below which the adverse effect is not likely to be observed upon lifetime (chronic) or a portion of lifetime (subchronic) exposure. Chemical intakes that are expected to result in no adverse effects to humans are referred to by EPA as RfDs. The EPA defines a chronic RfD as an estimate of a daily exposure level for the human population that is unlikely to result in deleterious effects, even to sensitive subpopulations (e.g., the very young or very old), during a lifetime (75 years). A chronic RfD is used to evaluate the potential noncarcinogenic hazards associated with long-term chemical exposures (7 years to a lifetime). Chronic RfDs were used to assess noncarcinogenic hazards for adult and child recreational receptors.

Subchronic RfDs have been developed to characterize potential noncarcinogenic hazards associated with shorter-term chemical exposures. The EPA (EPA 1989) defines subchronic exposure as periods ranging from 2 weeks to 7 years. Subchronic RfDs tend to be higher, generally by an order of magnitude, than chronic RfDs because a higher dose can be tolerated for the shorter exposure duration. Excavation/construction workers are expected to be on site for one year or less; therefore, the subchronic RfD was used to evaluate potential exposures.

To develop the RfD, the threshold dose or no-observed-adverse-effect level (NOAEL) is identified through studies with experimental animals. A NOAEL is an experimentally determined highest dose at which there was no statistically or biologically significant effect of concern, often called the "critical toxic effect." For certain substances, only a LOAEL, or "lowest-observed-adverse-effect level," has been determined. This is the lowest dose of a substance that produces either a statistically or biologically significant indication of the critical toxic effect. The NOAEL or the LOAEL may be used to calculate the RfD of a particular chemical. EPA bases the RfD on the most sensitive animal species tested (i.e., the species that experiences adverse effects at the lowest doses). In some cases, RfDs may be based on human epidemiological data.

RfDs are generally calculated by dividing the NOAEL (or LOAEL) by uncertainty factors, which generally range from 10 to 1,000. Uncertainty factors are intended to account for specific types of uncertainty inherent in extrapolation from one exposure route to another, extrapolation of data from laboratory animals to humans, variations in species sensitivity, variations in sensitivity among individuals within a species, limitations in exposure duration in animal experiments, and other limitations in the experimental data. Experimental animal data have historically been relied upon by regulatory agencies and other expert groups to assess the hazards of human chemical exposures. Although this reliance has been generally supported by empirical observations, there are known interspecies differences in chemical adsorption, metabolism, excretion, and toxic responses. There are also uncertainties concerning the relevance of animal studies using exposure routes that differ from the human exposure routes under consideration. Additionally, extrapolating results of short-term or subchronic animal studies to long-term exposures in humans has inherent uncertainty.

Despite the many limitations of experimental animal data, such information is essential for chemical toxicity assessment, especially in the absence of human epidemiological evidence. The uncertainty factors used in the derivation of RfDs are intended to compensate for data limitations. Synergistic effects may occur when the adverse effect of one chemical is greater in the presence of a second chemical than if the exposure were to one chemical alone. Antagonistic effects may occur when two chemicals interfere with each others actions or one interferes with the action of the other chemical (EPA 1986b).

The method of deriving human RfDs from short-term studies in sensitive animals is conservative by design and introduces the potential to overestimate, but very likely not underestimate, noncarcinogenic effects. The methodology for deriving RfDs is more fully described in the EPA's current human health risk assessment guidance (EPA 1989).

The RfD is expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day). At the present time, RfDs are only available for two PCB mixtures: Aroclor 1016 and Aroclor 1254. The RfD for Aroclor 1254, obtained from IRIS (EPA 2000) on-line database system, is 2×10^{-5} mg/kg-day. The uncertainty factor incorporated into the chronic RfD is 300. The subchronic RfD for Aroclor 1254, obtained from HEAST (EPA 1997b), is 5×10^{-5} mg/kg-day. The uncertainty factor incorporated into the subchronic RfD is 100. The Aroclor 1254 RfDs were used as surrogate values for all the detected Aroclor mixtures.

EPA recognizes that, even with the application of uncertainty factors, RfDs are provisional estimates with uncertainty perhaps spanning an order of magnitude or more (EPA 1997b). EPA rates the confidence level of verified RfDs as high, medium, or low. EPA rates the confidence level of the Aroclor 1254 chronic RfD as medium (EPA 2000).

V.C.1.4.2 Slope Factors for Carcinogenic Effects

In estimating the potential risk posed by potential carcinogens, it is the practice of the EPA and other regulatory agencies to assume that any exposure level has a finite probability, however minute, of producing a carcinogenic response. EPA assumes that a small number of molecular events can evoke changes in a single cell that can lead to uncontrolled cellular proliferation. This mechanism for carcinogenicity is referred to as "nonthreshold" since there is theoretically no level of exposure for such a substance that does not pose a small probability of producing a carcinogenic response. The EPA assigns the substance a weight-of-evidence classification that describes the likelihood, based on scientific evidence, that the substance is a human carcinogen. Given sufficient data, an SF is then calculated, with a selected computer model specific for the assumed mechanism of action for carcinogenesis, that describes quantitatively the relationship between average lifetime dose and carcinogenic risk (EPA 1986a).

The SFs are based primarily on the results of animal studies. There is uncertainty whether animal carcinogens are also carcinogenic in humans. While many chemical substances are carcinogenic in one or more animal species, only a small number of chemical substances are known to be human carcinogens. The EPA assumes that humans are as sensitive to all animal carcinogens as the most sensitive animal species. This policy decision introduces the potential to overestimate, but very likely not to underestimate, carcinogenic risk.

A number of mathematical models and procedures have been developed to extrapolate from carcinogenic responses observed at high doses in experimental animals to responses expected at low doses in humans. The EPA uses a linearized multistage model for low-dose extrapolation. This conservative mathematical model is based on the multistage theory of carcinogenesis wherein the response is assumed to be linear at low doses. The EPA further calculates the upper 95th percent confidence limit of the slope of the resulting dose-response curve. This value, the SF, expressed in units of $(mg/kg\text{-}day)^{-1}$, is used to convert the average daily intake of a chemical, normalized over a lifetime, directly to an estimate of cancer risk. The resulting risk estimate represents an estimation of an upper-bound lifetime probability that an individual will develop cancer as a result of exposure to a potential carcinogen. This model provides a conservative estimate of cancer risk at low doses, and is likely to overestimate the actual cancer risk. The EPA acknowledges that actual risk is likely to be less than the estimate calculated with the SF using the linearized multistage model (EPA 1989), and in fact may be zero.

EPA classifies the PCBs, as a group as a B2 probable human carcinogen. At the present time, there is a SF available for PCBs as a class. Therefore, excess cancer risks were evaluated using total PCBs only. The SF for the PCB class, obtained from IRIS (EPA 2000) on-line database system, is 2.0 $(mg/kg\text{-}day)^{-1}$.

V.C.1.4.3 Sources and Uses of Toxicity Information

IRIS is a EPA database containing health risk and regulatory information for numerous chemicals. According to the EPA, IRIS is the primary source of toxicity data to be used in a risk assessment. Only toxicity factors that have been verified by EPA science work groups are included in IRIS. The chronic RfD and SF used in this risk assessment were obtained from IRIS. The subchronic RfD used in the risk assessment was obtained from HEAST 1997 (EPA 1997b).

Table 5.29 summarizes the subchronic and chronic RfDs, sources, uncertainty factors, confidence level, critical effect, and experiment used to derive the RfDs for the PCBs evaluated in the risk assessment. Table 5.30 summarizes the SFs, sources, weight of evidence classification, critical effect, and experiment used to decide the SFs for the PCBs evaluated in the risk assessment.

Dermal Toxicity Values

Most RfDs and SFs are expressed as administered dose. Exposure estimates for the dermal pathway are expressed as absorbed dose. For the dermal pathway, it is necessary to adjust oral toxicity values from administered to absorbed doses based on the type of chemical (e.g., organic, inorganic, etc.). PCBs are considered to be semi-volatile organic compounds (SVOCs). EPA has recommended oral absorption efficiencies of 89 percent for SVOCs[1].

Most RfDs and SFs are expressed as an administered dose. Exposure estimates for the dermal pathway are expressed as an absorbed dose. However, EPA (1998) recommends against adjusting oral toxicity values for oral absorption efficiency. Therefore, the oral toxicity values were used to evaluate dermal toxicity in this HHRA.

V.C.1.5 Risk Characterization

Risk characterization combines the outputs of the exposure and toxicity assessments to develop quantitative estimates of risks associated with exposures to COPCs released from each site. The risk characterization should present the risk estimates in an unbiased manner and explain the uncertainties associated with the calculation of the risk estimates. Both central tendency and RME risks were calculated for each receptor at the site.

V.C.1.5.1 Hazard Index for Noncarcinogenic Effects

The potential for noncarcinogenic effects is characterized by comparing estimated chemical intakes with chemical-specific RfDs. The RfD is considered to be the average daily dose (in terms of mg chemical/kg body weight per day) that is not likely to result in adverse effects even to sensitive individuals over a lifetime of exposure. Chemical intake is the chemical concentration in the exposure medium multiplied by the pathway-specific intake factor. The intake factors were estimated in Section V.C.4.1. Table 5.28 summarizes the intake factors for all potentially exposed populations and exposure pathways. The ratio of the estimated intake to the RfD is called a hazard quotient (HQ), which is calculated as follows:

$$\textit{Noncancer Hazard Quotient (HQ)} = \frac{\textit{Chemical Intake (mg/kg - day)}}{\textit{RfD (mg/kg - day)}}$$

It should be noted that the level of concern does not increase linearly as the RfD is approached or exceeded. This is because all RfDs have built-in safety or modifying factors and are generally specific to experimental conditions. Furthermore, the HQ does not represent a statistical probability of an effect occurring. The HQ provides a rough measure of potential toxicity, but it is conservative and dependent on the quality of the experimental evidence. Since the HQ does not define dose-response relationships, its numerical value cannot be construed as a direct estimate of the magnitude of risk (EPA 1986b).

For each receptor category (i.e., excavation workers, construction workers, and recreational) at each location, HQs were summed for all COPCs and their relevant exposure pathways to yield a total hazard index (HI). A HI equal to or less than 1.0 indicates that no adverse noncarcinogenic

[1] The value of 89 percent was cited in the document "Responses to Missouri Department of Natural Resources Comments on the Baseline Risk Assessment Component of the RFI Report for the 95th Terrace Site".

health effects are expected to occur even to sensitive individuals over a lifetime of exposure. A HI above 1.0 indicates a potential cause for concern for noncarcinogenic health effects and the need for further evaluation of assumptions about exposure and toxicity (for example, effects of several different chemicals are not necessarily additive, although the hazard index approach assumes additivity).

The assumption of additive effects reflected in the cumulative HI is most properly applied to substances that induce the same toxic effect by the same mechanism (EPA 1986b). Additivity of effects is assumed for PCBs in this risk assessment. Therefore, PCBs were assumed to have the same target organs and mechanism of action regardless of the Aroclor mixture.

V.C.1.5.2 Carcinogenic Risk

Potential carcinogenic effects are characterized in terms of the excess probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Excess probability means the increased probability over and above the normal probability of getting cancer (i.e., background risk), which in the United States is 1 in 3 (American Cancer Society 1990).

Excess lifetime cancer risk is calculated by multiplying the average daily chemical intake by the cancer SF, which is a risk-per-unit chemical intake:

$$Risk = Chemical\ Intake\ (mg / kg - day) \times SF\ (mg / kg - day)^{-1}$$

For each receptor category at each location, cancer risks were calculated separately for each carcinogen and each exposure pathway, and the resulting risks are summed to yield a total upper-bound estimate of cancer risk due to multiple exposures. This is a conservative approach that can result in an artificially elevated estimate of cancer risk, especially if several carcinogens are present. This is because 95th percentile estimates may not be strictly additive (EPA 1986a). RME cancer risks are likely to be overestimated significantly because they are calculated by multiplying together 95th percentile estimates of cancer potency and RME of concentration and exposure. The approach also ignores potential antagonistic or synergistic effects.

The following guidance should be considered in order to interpret the significance of the cancer risk estimates. In the National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990c), EPA states that: "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6}." These values are equivalent to a 1 in 10,000 to 1 in 1,000,000 chance of getting cancer from the exposure. These risk levels are extremely low and would not be measurable or discernible (compared to the background cancer risk of 1 in 3) in individuals or even in a large population. For example, a risk level of 1 in 10,000 (1×10^{-4}) would increase an individual's chance of getting cancer from the background risk of 1 in 3 to 1.0001 in 3. The Guidance on Risk Characterization for Risk Managers and Risk Assessors (EPA 1992b) and the RCRA Subpart S proposed rules (EPA 1990a) concur with the 1×10^{-6} to 1×10^{-4} target risk range.

V.C.1.5.3 Risk Assessment Results

Noncarcinogenic hazards and carcinogenic risks for excavation workers, construction workers, adult recreational receptors and child recreational receptors were estimated for all relevant exposure pathways using the approach described in Sections V.C.1.1 through V.C.1.5.

Excavation Worker

The excavation worker was assumed to be exposed (via ingestion and dermal contact) to contaminated deep soils. The excavation workers were assumed to be exposed for 8 hours/day, 15 and 30 days/year, over 1 year for the central tendency and RME cases, respectively. These assumptions are conservative because it is unlikely that any trenching activities associated with the 95th Terrace Site would take 15 or more days to complete. Tables 5.31 and 5.32 present the calculated excavation worker risks. Table 5.33 summarizes the results of the risk assessment.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway subchronic exposure to deep soils via the ingestion and dermal contact pathways is 0.01 and 0.1 in the central tendency and RME cases, respectively. Both the central tendency and RME HI values are below the EPA target value of 1.0.

The data set used to evaluate excavation worker exposure was composed of deep soils (> 10 feet bgs). However, most of the PCB contamination was detected at depths >30 feet bgs. See the uncertainties section for a discussion of the effect of this spatial distribution on the risk results. The data set used to evaluate excavation worker exposure was composed of deep soils (>10 feet bgs). However, most of the PCB contamination was detected at depths >30 feet bgs. Many detected concentrations were greater that 100 mg/kg and several were greater than 1,000 mg/kg. Despite these high concentrations, adverse health effects were estimated to be below EPA target levels (HI <1.0). In order to determine if potential health effects were diluted by a large number of nondetect samples from across the site, data analysis was conducted to identify potential hot spots. First, a cursory review of the data indicated that PCBs were detected across the site, with no horizontal spatial breaks in the detection pattern. However, the highest concentrations are located predominantly on the west-northwest side of 95th Terrace. Therefore, potential risks were evaluated from soils located west-northwest of 95th Terrace and soils located east-southeast of 95th Terrace. Although the risk analysis of this data distribution indicated that estimated adverse health effects were higher for soils located on the west-northwest side of 95th Terrace than on the east-southeast side or the data as one group, the risks were still below the EPA target levels.

Any construction activities for the 95th Terrace Site would likely involve both sides of the street. Therefore, based on the data distribution analysis and potential exposure patterns the single deep soil data set and the application of the 95 percent UCL methodology were considered appropriate for this site.

Vertical distribution of the data set was also considered. As stated earlier, most of the PCBs were detected in depths > 30 bgs. In the data set for the risk assessment, non-detect data from the more shallow samples was included because excavation workers would also be exposed to these soils during excavation activities. The exclusion of these samples would have resulted in a significantly higher HI. Therefore, it is important to note that isolated areas corresponding to sample locations with high PCB concentrations (greater than 1.0 mg/kg, EPA 2000b) may pose some health concerns if worker activities are centered on these high concentration areas throughout the duration of exposure.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 1×10^{-8} in the central tendency case and 3×10^{-7} in the RME case. Both the central tendency and RME excess cancer levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Utility Worker

The utility worker was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water. The construction workers were assumed to be exposed for 8 hours/day, 15 and 30 days/year, over 1 year for the central tendency and RME cases, respectively. These assumptions are conservative because it is unlikely that any utility maintenance activities associated with the 75th Terrace site would take 15 or more days to complete. Tables 5.34 through 5.35 present the calculated construction worker risks. Table 5.36 summarizes the results of the risk assessment.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway subchronic exposure to shallow soils via the ingestion and dermal contact pathways is 0.03 and 0.33 in the central tendency and RME cases, respectively. Both the central tendency and RME HIs are below the EPA target value of 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 2×10^{-9} in the central tendency case and 5×10^{-8} in the RME case. Both the central tendency and RME excess cancer levels are below the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Construction Worker

The construction worker was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water. The construction workers were assumed to be exposed for 8 hours/day, 15 and 30 days/year, over 1 year for the central tendency and RME cases, respectively. These assumptions are conservative because it is unlikely that any construction activities associated with the 002 Outfall and adjacent area of Indian Creek would take 15 or more days to complete. Tables 5.37 through 5.40 present the calculated construction worker risks. Table 5.41 summarizes the results of the risk assessment.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway subchronic exposure to sediments and surface water via the ingestion and dermal contact pathways is 7.1 and 66 in the central tendency and RME cases, respectively. Both the central tendency and RME

HIs exceed the EPA target value of 1.0. Dermal contact with Aroclor 1242 in sediments was the primary contributor to the HI. However, dermal contact with surface water and ingestion of Aroclor 1242 in sediments also had hazard quotient values greater than 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 5×10^{-7} in the central tendency case and 9×10^{-6} in the RME case. Both the central tendency and RME excess cancer levels are within or below the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Adult Recreational Receptor

The adult recreational receptor was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water at 002 Outfall and in Indian Creek. The adult recreational receptor was assumed to be exposed for 2 to 4 hours/day, 26 to 52 days/year, over 9 and 30 years for the central tendency and RME cases, respectively. Adult recreational receptors were also assumed to ingest 16 and 45.2 grams/day of fish, in the central tendency and RME cases respectively. This scenario assumes that the fraction of contaminated fish is 10 percent in the average case and the 25 percent in the RME case. These assumptions are conservative because it is unlikely that an adult would visit the area 2 to 3 times per week for 9 to 30 years. Additionally, while Indian Creek supports a fish population, it does not support a large fish population. Tables 5.42 through 5.47 present the calculated adult recreational receptor risks. Table 5.48 summarizes the results of the risk assessment.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway chronic exposure to contaminated sediments, surface water and fish via the ingestion and dermal contact pathways is 1.0 and 7.7 in the central tendency and RME cases, respectively. The central tendency value does not exceed the EPA target value of 1.0. The RME HI exceeds the EPA target value of 1.0. Ingestion of Aroclor 1254 in channel catfish was the major contributor to the HI. However, dermal contact with surface water also had an RME hazard quotient greater than 1.0.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 5×10^{-6} in the central tendency case and 9×10^{-5} in the RME case. Both the central tendency and RME levels are within the EPA target risk range of 1×10^{-6} to 1×10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

Note: PCB sediment and surface water concentrations in Indian Creek and at the Indian Creek/Blue River confluence were nondetect. Two surface soil samples were collected up the hill from the creek. These samples contained PCBs. The potential adverse health effects and excess cancer risks were estimated using surface water and sediment PCB concentrations collected within the 002 Outfall Raceway or the very near vicinity, in addition to the few surface soil and Indian Creek samples available. The Raceway area is not enclosed in a fence, and therefore, it is accessible by the public. However, the Raceway is not located adjacent to any road or sidewalk access areas. Additionally, the area is covered by dense vegetation (e.g., grasses, trees, and shrubs). The physical location of the Raceway area makes frequent and regular visits by any receptor unlikely.

Using only surface soil, surface water, and sediment data from Indian Creek or its confluence with the Blue River and the fish data would result in a RME HI of 6.53. Although this concentration still exceeds the EPA target level of 1.0, cumulative surface soil, surface water and sediment adverse health effects would be below 1.0 (0.96). (The data for surface water and sediments in this specific data set were all nondetect. One-half the highest reporting limit [0.05 μg/L and 16.5 μg/kg], was used to evaluate the individual Aroclor mixtures as well as the total PCBs.)

Child Recreational Receptor

The child recreational receptor was assumed to be exposed (via ingestion and dermal contact) to contaminated sediments and surface water at 002 Outfall and Indian Creek. The child recreational receptor was assumed to be exposed for 2 to 4 hours/day, 26 to 52 days/year, over 9 years for the central tendency and RME cases, respectively. Child recreational receptors were also assumed to ingest 8 and 23 grams/day of fish, in the central tendency and RME cases, respectively. This scenario assumes that the fraction of contaminated fish is 10 percent in the central tendency case and the 25 percent in the RME case. These assumptions are conservative because it is unlikely that a child would visit 002 Outfall/Indian Creek 2 to 3 times per week for 9 years. Tables 5.49 through 5.54 present the calculated child recreational receptor risks. Table 5.55 summarizes the results of the risk assessment.

The total HI calculated for noncarcinogenic health effects due to multiple-pathway chronic exposure to PCBs in sediments, surface water and fish via the ingestion and dermal contact pathways is 1.0 and 7.8 in the central tendency and RME cases, respectively. The central tendency value does not exceed the EPA target value of 1.0. The RME HI exceeds the EPA target value of 1.0. Ingestion of Aroclor 1254 in channel catfish is the primary contributor to the HI. However, dermal contact with surface water has hazard quotient greater than 1.0 (2.69).

As discussed for the adult recreational receptor, minimal surface water and sediment data was available from Indian Creek/Blue River and these samples were nondectect. Two surface soil samples contained PCBs, although these were included with the sediments and surface water they are located up the hill from the creek. Using the data set that excludes the 002 Outfall Raceway data, as described for the adult recreational receptor, to evaluate potential adverse health effects brings the RME HI to 5.3. The risk driver is ingestion of contaminated fish (4.21). Although this concentration still exceeds the EPA target value of 1.0, the cumulative surface soil, surface water, sediment adverse health effects would be near 1.0 (1.1). Since dermal contact with surface water provides the next highest hazard quotient (0.57) it is important to remember that surface water samples were nondetect for PCBs and one half the reporting was used to estimate potential health effects.

The estimated total lifetime excess cancer risk under the assumed chronic exposure conditions is 4×10^{-6} in the central tendency case and 4×10^{-5} in the RME case. Both the central tendency and

RME level are within the EPA target risk range of 1 x 10^{-6} to 1 x 10^{-4} for exposure to chemicals released from hazardous waste sites (EPA 1990a, 1990b, 1991c).

V.C.1.5.4 Summary

The HHRA indicates excess cancer risks for all receptors were within the EPA target range of 1 x 10^{-6} to 1 x 10^{-4}. The HHRA also indicate that no adverse health effects were likely for the excavation and utility workers.

Ingestion of Aroclor 1254 in channel catfish is the primary contributor to the adverse health effect estimates for the adult and child recreational receptors. However, dermal contact with surface water also resulted in RME hazard quotients greater than 1.0 for these receptors.

Ingestion of Aroclors in sediments, dermal contact with Aroclors in sediments, and dermal contact with Aroclors in surface water all resulted in estimated HIs greater than 1.0 for both the central tendency and RME construction worker exposure scenarios. However, dermal contact with Aroclors in sediments was the primary driver for the construction worker.

The sediment and surface water concentrations contributing significantly to the hazards for construction workers and recreational receptors were associated with 002 Outfall and not the creek itself. Table 5.56 summarizes the risk assessment results for all receptor populations.

An Applicable or Relevant and Appropriate Requirements (ARARs) decision is provided in Attachment 5.4.

V.C.1.6 Uncertainties and Limitations

Throughout the human health HHRA, conservative assumptions were used that probably overestimate actual risks at each site. Although some uncertainties may exist that may underestimate risk, the overall conservative features of the HHRA process are likely to compensate for them and yield an upper-bound estimate of potential risk. The important factors that tend to over- or underestimate risk are discussed below.

V.C.1.6.1 Factors that Tend to Overestimate Risk

- EPA RfD for Aroclor 1254 is based on conservative estimates of the potential for adverse noncarcinogenic effects. Reducing the dose at which no adverse effects were observed in the most sensitive animal species by uncertainty factors ranging from 10 to 10,000 develops most RfDs. For chemicals with oral toxicity factors based on experiments that used a liquid vehicle, the extrapolation method provides a considerable level of conservatism in the RfDs and could result in an overestimate of potential hazards by one or more orders of magnitude.
- EPA SF for PCBs is highly conservative estimates of dose-response relationships and probably result in a significant overstatement of actual cancer risk. Cancer SFs are calculated using the 95 percent UCL on a dose-response curve estimated by a linear mathematical model that extrapolates from short-term, high-dose animal exposures to

long-term, low-dose human exposures. EPA guidance states that the cancer SFs are upper-bound estimates of potency, and actual potency is likely to be lower.

- Data from a number of soil, sediment, surface water, and fish tissue sampling investigations were assumed to be representative of the areas where receptors may be exposed. However, sampling-associated uncertainty can be introduced through biases in sampling and to random variability of samples. In addition, sediment, surface water, and fish are not homogeneously distributed in the environment. A biased sampling approach, for example targeting suspected hot spots and subsequently incorporating the data into a statistical analysis that assumes randomness, will positively bias the results and lead to an overestimation of risk. In the case of the 95th Terrace sampling program, soil samples appear well distributed, and sampling bias appears minimal.
- There are also temporal issues associated with sampling that affect interpretation of risk. Soil data were collected between 1988 and 1999. For fish, data were collected from 1991 to 1999. Historical data suggest surface water PCB discharges have decreased, and concentrations in sediments of Indian Creek were substantially higher than at present. Though sediments were not a significant source of risk in the evaluation, the attenuation of PCBs in both surface water discharges and in sediments over time has occurred. Whether this attenuation will continue is unknown, which represents an uncertainty, though if it did, would suggest an overestimation of risk.
- Arithmetic mean concentrations and 95th percentile upper confidence limits (UCL) on the mean concentrations were compiled for PCBs in sediment and fish tissue. For RME exposure scenarios, the 95ht percentile UCL concentrations were used to estimate risks, which likely results in over-estimation of potential risk.
- The arithmetic mean and 95th percentile UCL concentrations at the site were used as exposure point concentrations. The potential reduction in chemical concentrations by migration, degradation, and attenuation were not considered. In reality, these processes would reduce the chemical concentrations for future exposure scenarios and during the assumed exposure periods considered in the risk assessment. As a result, the use of these data likely over-estimates potential health risks at the site.
- The average case scenarios represent assumptions that are considered central values, or realistically conservative estimates for the exposed population. However, even the average case scenarios assume individuals are exposed on a regular basis over a long period of time, which is an assumption that likely over-estimates actual exposures. The RME scenarios are developed to provide an upper bound risk estimate. The RME scenarios are based upon a combination of conservative assumptions for all variables related to exposure, and thus are highly likely to over-estimate potential risks.
- Because there are uncertainties in each step of the risk assessment process, these uncertainties are often magnified in the final risk characterization. The final quantitative estimates of risk may be one or several orders of magnitude different from the potential risk associated with a given exposure. Because of the conservative approaches used in each step,

the overall results of the human health risk assessment are more likely to overestimate than to underestimate the potential risk.

V.C.1.6.2 Factors that Tend to Underestimate Risk

- The risk assessment indicates that adverse health effects and unacceptable cancer risks for excavation workers are unlikely at this site (based on the assumed exposure scenarios). However, the inclusion of the shallow non-detect data lowers the calculated exposure concentration. This subsequently reduces the estimate of risk

V.C.1.6.3 Factors that May Over- or Underestimate Risk

- Rates of soil ingestion, soil matrix effects, gut absorption, dermal adherence, and dermal absorption were selected to bracket "best estimate" (central tendency) and "reasonable maximum" rates. The values may overestimate or underestimate actual rates. However, values used in the RME scenario are selected to provide an upper-bound estimate of the maximum exposure (and risk) that could reasonably be expected to occur at this site.
- Cumulative noncarcinogenic and carcinogenic health risks were estimated assuming that effects of individual PCBs are additive. This approach does not account for potential synergism, antagonism, or differences in target-organ specificity and mechanism of action. This approach may over- or underestimate actual health risks.
- The use of Aroclor 1254 as a surrogate to evaluate noncarcinogenic health effects of other detected PCBs, which do not have EPA-established toxicity factors, may over- or underestimate actual health risks.
- Minimal data was available for use in the risk assessment regarding exposures to sediment and surface water in Indian Creek and its confluence with the Blue River. Much of the available data was nondetect for all PCBs. Given the high concentrations of PCBs detected within the 002 Outfall Raceway and stream fish, the small surface water and sediment data sets do not seem to be representative of potential exposure concentrations. Waterways are dynamic entities that are impacted by rainfall, drought, etc. Although, dilution likely plays a role in lowering the released concentrations once they reach the creek, there is still uncertainty regarding creek concentrations based on the small samples set. Therefore, potential risks could be under- or overestimated.
- Some species of fish are mobile and can move between contaminated and non-contaminated areas. This could result in under-or overestimating risk. Because of the large database available for fish, both in terms of number of samples and temporal dimension, the uncertainty associated with this is small.
- Random variability and lack of homogeneity of the media sampled may result in either an over- or under-estimation of actual exposure concentrations, and thus, site risks. However, the impact of random variability and homogeneity in samples is minimized by having adequate sample sizes, and using a statistical approach to derive an upper confidence limit to represent the RME.

- Samples were analyzed using EPA-approved procedures, and were subjected to data quality review procedures, to assure that data were suitable for use in decision-making. However, it should be understood that sample analysis is subject to uncertainties associated with precision and accuracy, and detection of chemicals at low concentration. Analytical precision and accuracy are evaluated through laboratory quality assurance (QA) programs. Uncertainties associated with precision and accuracy of analysis are generally random, and may lead to over- or under-estimation of risks. For example, the only detectable concentrations of PCBs in sediments were near the 002 Outfall discharge, suggesting they are very localized. Likewise, PCBs have not been detected in surface water of Indian Creek or Blue River, though it is known they were present in the 002 Outfall discharge. It is probable that PCBs are present below detectable levels in downstream areas in both surface water and sediments, which could lead to an underestimate of risk. Conversely, non-detect values within specified study boundaries are included in the risk evaluation at ½ the detection limit, even though they may or may not actually be present. While these errors are typically of low magnitude compared to other sources of uncertainty in the risk assessment, lack of analytical resolution can lead to a possible over- or under-estimation of risk.
- In evaluating data, it was generally assumed that a chemical not detected in a given sample was actually present at one-half of its detection limit. The arithmetic mean concentration, which incorporated these half-detection values, was used in evaluation of average exposure scenarios. This approach, as described in RAGS, is a conservative approach that may lead to an over- or under-estimation of risk.
- No site-specific information was available to evaluate the recreational scenario with regards to the fishing exposures. Therefore, a value was selected from the *Exposure Factors Handbook* (USPEA 1997) for ingestion of freshwater fish. This ingestion rate was selected based on evidence from the site walkover and demographics of the immediate area around the site. This may lead to an over- or under-estimation of risk.
- PCB concentrations also vary according to the species and size of fish. Fish data available for Indian Creek and Blue River were limited primarily to green sunfish and channel catfish. These fish are believed to be reasonably representative of the types of fish receptors may consume. However, differences in the proportions and types of fish captured and eaten will result in variability in the PCB intake, which may result in an under- or over-estimate of risk.

V.C.1.7 References

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V.D.2 ECOLOGICAL RISK ASSESSMENT

Prior to the late 1980s there was no official federal guidance for performance of ecological risk assessments. In 1989, *Risk Assessment Guidance for Superfund: Volume II - Environmental Evaluation Manual, Interim Final* (commonly referred to as RAGS II; EPA/540/1-89/001A [EPA 1989a]) and a companion document, *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference* (EPA/600/3-89/013 [EPA 1989b]), were issued. RAGS II was generally regarded as interim guidance while the EPA Risk Assessment Forum developed a basic structure and consistent approach for an agency-wide process. This came in the form of the *Framework for Ecological Risk Assessment* (EPA/630/R-92/001; hereinafter referred to as the *Framework* or EPA [1992]). On August 12, 1994, the EPA Office of Solid Waste and Emergency Response (OSWER) issued a directive which stated that ecological risk assessments would be conducted at all CERCLA sites consistent with the *Framework* (OSWER Directive No. 9285.7-17). The OSWER Directive also noted that program-specific guidance for such assessments would be provided by the EPA Emergency Response Team (ERT). The resulting document, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (herein referred to as ERAGS or EPA [1997]), was published in June 1997. In January 1998, EPA published *Guidelines for Ecological Risk Assessment* (EPA/630/R-95-002F). This document expands upon and replaces the *Framework.* ERAGs and the *Guidelines for Ecological Risk Assessment* provide direction for designing and performing this ecological risk assessment.

The primary guidance that was used for this ecological risk evaluation is the *Guidelines for Ecological Risk Assessment.* The ecological risk assessment (ERA) was conducted as a "desk-top" evaluation, that is, it relies upon existing information. The overall evaluation consists of three major components that comprise EPA's general approach as outlined in *Guidelines for Ecological Risk Assessment.* These are (1) *Problem Formulation*; (2) *Risk Analysis*; and (3) *Risk Characterization. Problem Formulation* is the process of establishing the goals, breadth and focus of the ecological risk assessment (EPA 1998). Problem formulation begins by evaluating available information to identify and characterize: (1) the contaminants known or suspected to be present; (2) the ecosystem(s) potentially at risk; and (3) the anticipated ecological effects. This leads to the identification of ecologically relevant endpoints that are the actual values to be protected (*assessment endpoints*). A conceptual model identifies and describes complete exposure pathways, providing a basis for selection of *measures of exposure* and *measures of effect* that are linked to the assessment endpoints. For higher trophic level organisms, receptors are selected that are representative of each the assessment endpoints. These are referred to as Receptors of Concern (ROCs).

The *ecological risk analysis* requires: (1) the distribution of the chemical of potential ecological concern (COPEC) in exposure media (soil, sediment, food, and/or water) specific to a ROC (Exposure Assessment); and (2) a credible literature-based toxicological effect level (Effects Assessment). In general, the measure of effect in the desktop evaluation is a comparison of the dose an ROC receives (the environmental exposure concentration, EEC) to a literature-derived toxicity reference value (TRV). The ratio between the TRV and the EEC is termed the ecological effects quotient (EEQ). The subsequent calculation and interpretation of the EEQ is the *Risk Characterization*.

V.D.2.1 ECOLOGICAL PROBLEM FORMULATION

The first consideration in problem formulation is the identification of COPECs. COPECs are defined as chemicals which may have been released to the environment in quantities sufficient to pose a potential risk to ecological receptors. Specifically, polychlorinated biphenyls (PCBs) that have been released to the 95th Terrace Site, and Indian Creek present the COPECs for this ERA. As discussed in Section V.C.1, only Aroclors 1242, 1248, 1254 and 1260 have been detected at the 95th Terrace Site and Indian Creek. Other Aroclors were not considered since they have not been detected in soils, sediments, surface water, or biological tissue.

A discussion of the nature and extent of contamination associated with PCBs was discussed in Sections III.C.2 and III.C.3. Abiotic media considered in the ERA are soils, surface water and sediments. Nearly all PCBs in soils associated with the 95th Terrace Site are covered by tens of feet of clean soil, and thus represent incomplete exposure pathways to ecological receptors, including burrowing animals. The only exception to this is near Well 233, where PCBs are potentially present at the surface at concentrations less than 1 mg/kg (0.44 mg/kg) (Section III.C.2.a.i and Figure 3.19), and concentrations up to 2.9 mg/kg at a depth of 5 ft. Because PCB concentrations are relatively low, and this area is extremely limited in size (e.g., on the order of hundreds of square feet rather than acres), exposures are extremely limited. Though invertebrates and individual organisms with small area uses (such as mice and some birds) could potentially be exposed, the concentrations are low, and even if there is a potential for effects, they would not be expressed at the population level since the area is so small. Therefore, exposure pathways in soils are not believed to be significant for ecological receptors and the 95th Terrace Site was evaluated further in this ERA. Surface water and sediments associated with Indian Creek are considered the primary media of concern, since predominant physical transport of PCBs from the site was via 002 Outfall to Indian Creek.

A number of surface water samples have been collected in the 002 Outfall channel indicating that PCBs have been, and continue to be, released to Indian Creek. PCB concentrations in the 002 Outfall are typically about 0.6 to 0.7 µg/L. However, PCBs were not detected in surface waters of Indian Creek or Blue River during 1998 or 1999 (detection limit 0.1 µg/L). Sampling occurred during low flow conditions when the potential instream concentrations would be highest. Detectable concentrations of PCBs in sediments were limited to the immediate area around 002 Outfall. PCBs were detected at concentrations between 0.48 mg/kg and 2.3 mg/kg in 1998 and 1999 (Figure 3.13) near 002 Outfall. PCBs were not detected in any other sediment sampling locations in Indian Creek or Blue River.

From the standpoint of the ERA, perhaps the most illuminating data available for the evaluation of Indian Creek are biological data. Studies evaluating both fish and benthic macroinvertebrate communities in Indian Creek and Blue River were conducted in 1999 (ORNL 2000). These data are directly applicable to the evaluation of these communities. In addition, fish tissue PCB data have been collected that are applicable to the interpretation of potential risks to receptors that may forage in Indian Creek. Fish tissue data, comprised predominantly of green sunfish and channel catfish, were collected in 1991, 1992, 1993 and 1998. Biological data are discussed in greater detail in Section V.C.2.1.2.

V.D.2.1.1 Ecosystem at Risk

The second key element of problem formulation is defining and characterizing the ecological context, or eco*system*, within which effects might occur (EPA 1992). Generally defined, an ecosystem is "the biotic community and abiotic environment within a specified location and time" (EPA 1992). On a more specific or operational level, ecosystems can be defined in various ways (Evans 1956), but they are usually thought of in terms of salient physical limitations on the biotic components -- i.e., aquatic *versus* terrestrial systems.

There are two interrelated ecosystems potentially at risk in the study area: (1) aquatic portions of Indian Creek and Blue River; and (2) the "terrestrial" system that comprises the adjacent riparian corridor. Receptors associated with these streams include both strictly-aquatic forms and semiaquatic forms. Strictly aquatic organisms are herein defined as plants and animals so adapted to total or partial immersion in water as to be dependent upon that immersion to complete their normal life cycles. Air-breathing organisms not absolutely dependent upon immersion in water but who are strongly adapted to life in or near water and derive most of their nourishment from aquatic systems are referred to as *semiaquatic organisms*.

Whereas the foregoing establishes the contextual boundaries of the risk assessment, it is also important to define the spatial or geographic boundaries. Because the stressors (COPECs) are PCBs, the information on the distribution of PCBs in environmental media is helpful in delineating the ecosystems potentially at risk (EPA 1992, 1997). In a spatial context, this ecological risk assessment focused on Indian Creek and Blue River where aquatic and semiaquatic receptors are subject to exposures to PCBs. The abiotic media of concern are surface water and sediments. PCBs have not been detected in surface water of Indian Creek, and detectable concentrations in sediments are limited to a confined area near 002 Outfall. This might suggest that exposures are limited to a very confined area. However, because of the propensity of PCBs to bioaccumulate and biomagnify, concentrations below detectable levels over a broader area are also be important. Of substantial benefit to the ERA are studies that have been conducted to evaluate biological communities (fish and benthic macroinvertebrates) in direct contact with sediment and surface water (ORNL 2000). As noted previously, fish tissue data are available for Indian Creek and Blue River. Because, biota exposed to PCBs in the water column or sediments act as repositories of PCBs, the fish tissue data was directly applied to the evaluation of potential exposures to fish and organisms which feed upon fish.

Physical Characteristics

Indian Creek and the Blue River lie in Johnson County, Kansas and Jackson County, Missouri, with portions of each body of water occurring in each of the two states. Indian Creek, a fourth-order stream originating in Kansas, flows 37.8 km in an east north easterly direction, before emptying into the Blue River approximately 4.8 km east of the Missouri border. Even though the first 7.9 km of Indian Creek have intermittent flow (Jeffries et al. 1993), it remains the single largest contributor of flow to the Blue River. At 80 km^2, the Indian Creek watershed is the largest sub-basin of the 435 km^2 Blue River basin. The Blue River, which also originates in Kansas, is a fifth-order stream, 65.5 km in length, and flows north northeast before emptying into the Missouri River. The Blue River basin is bisected by two subdivisions of the Central Lowland region of Missouri; the unglaciated Osage Plains, and the glaciated Dissected Till Plains.

Indian Creek and the Blue River have been substantially altered by channelization and urbanization within their watersheds. Near the Kansas City Plant (KCP) alone, nearly 800 km of Indian Creek and 3.5 km of the Blue River have been lost because of channelization (Korte and Stites 1998). Channelization projects near the KCP, occurred a number of times from 1953 to 1972, in order to accommodate construction of railroad tracks, highways, landfills, and flood-control levees. These efforts created reaches alongside the KCP that have broad, shallow channels and steep, muddy banks, virtually devoid of woody riparian vegetation and natural structure. Urbanization, wetland destruction, low gradient (0.76 m/kni for Blue River), and silty, clay soils that percolate slowly cause lower Indian Creek and the Blue River adjacent to the KCP to experience vast and rapid fluctuations in water level during precipitation events. Runoff within the Blue River basin has been described as ranging anywhere from moderately slow to very rapid, depending on soil type and extent of development (Jeffries et al. 1993). Average annual runoff is about 18 cm (Jeffries et al. 1993). Average annual precipitation is 91 cm (Johnson 1987, MDNR 1986).

Recent land use in the Blue River basin can be characterized by a shift away from rural/crop land agriculture to residential-commercial development/livestock grazing. Twenty-five years ago the upper basin was largely rural, but it has since undergone rapid commercial and residential expansion. In the late 1970s, the U.S. Fish and Wildlife Service (USFWS 1986) calculated surrounding land use for Indian Creek was 50% urban development, 24% cultivated, 14% grassland, 8% timber, and 4% industrial. Residential and commercial development has continued since this survey, fueled largely by the rapidly expanding population in Kansas.

Biological Characteristics and Conceptual Exposure Model

Degradation of habitat caused by channelization largely explains a general lack of streambed diversity and structure, lack of aquatic and riparian vegetation, and congruent increases in erosion, turbidity, and siltation in Indian Creek and Blue River. The adverse effects of channelization on these aquatic habitats are exacerbated by geography. The Blue River basin lies within the Prairie Faunal Region, an area characterized by a less-varied fish fauna than other faunal regions in Missouri. This results because prairie streams are subject to widely fluctuating environmental conditions, and only fishes tolerant of these conditions can persist (Pflieger 1975). Because of these highly fluctuating conditions, a case can be made for other regional fauna being less varied as well, including benthic macroinvertebrates, and aquatic-associated herpetofauna.

To interpret the likelihood and relevance of potential ecological changes, it is important to consider the functional roles of the ecological components, especially in terms of their trophic relationships. The following subsections describe the study area in the context of habitat, biological composition (structure), and system function. Habitat and composition are presented in the context of aquatic and terrestrial, or semiaquatic, *communities*. This discussion also forms the foundation of the conceptual exposure model for the ERA by identifying potentially complete and ecologically relevant exposure pathways to surface water and sediments. A diagrammatic presentation of the ecological site conceptual exposure model is presented in Figure 5.2.

Aquatic Communities

Aquatic communities are typically distinguished in the context of two basic physical macrohabitats (or media); that is, the water column versus submerged substrates (such as sediments or the surfaces of submerged plants and debris). In most systems there are further important subdivisions (e.g., neuston and nekton of the water column). Some algae and many of the animals are actually members of two or more communities. For example, most fish are nektonic as juveniles and adults, but their larvae (and some case fertilized eggs) are planktonic. "Aquatic" insects generally include species that are part of the benthos, aufwuchs, and/or "drift" communities while in various immature phases, but upon achieving adulthood some leave the water for a terrestrial phase and others do not. A discussion of aquatic communities in general, and potential relevance to the study area are provided in the following subsections.

The **neuston** is an assemblage of organisms associated with the surface film at the air/water interface (Thorp and Covich 1991a). The neuston of most lakes and ponds consists mainly of bacteria, algae, protozoans, microcrustaceans (especially certain cladocerans), water mites, spiders, and a variety of insects. Neustonic organisms are sometimes selectively preyed upon by certain fishes and higher vertebrates (e.g., birds). In terms of potential vulnerability to exposures to chemicals, the neustonic forms are in direct contact only with surface water. Because PCBs have not been detected in surface water of the creeks, and bioconcentration issues are of greater concern with PCBs, the neuston community is not considered directly relevant to the ecological risk evaluation.

The **plankton** community is generally divisible into an algal subdivision (phytoplankton), and assemblages of mainly invertebrate animals referred to here collectively as zooplankton. Plankton are an important component of the ecological structure in that they provide a basic food source upon which other organisms depend. Based on observations of Indian Creek, and Blue River, plankton probably play a much smaller role in these lentic systems where autochthonous material and attached algal communities (aufwuchs) probably play a more important role. As with the neuston, plankton are in contact with surface water. Because PCBs have not been detected in surface water of the creeks, and bioconcentration issues are a primary concern associated with PCBs, the plankton community is not considered directly relevant to the ecological risk evaluation.

The **nekton** community is essentially comprised of fish. According to long-term surveys (1966-Present) conducted by the Missouri Department of Conservation and Kansas Department of Wildlife and Parks, the diversity of the fisheries has not significantly changed during this period (Jeffries 1993). The fish community has historically indicated a depressed species richness and composition. In 1999, ORNL conducted a study to characterize the fish community in the general vicinity of KCP (ORNL 2000). ORNL surveyed 8 locations in the upper Blue River, Indian Creek, Wolfe Creek and Coffee Creek. The study found that the fish communities were comprised of an abundance of moderately tolerant species. The Blue River with its close proximity to the Missouri River had a considerable number of medium to large river fish species (buffalo, gizzard shad, common carp, freshwater drum) that would not be expected in smaller streams. Likewise, Indian Creek had species, which would normally be found in smaller streams (central stonerollers, creek chub, white sucker) and not larger tributaries.

Specifically, the fish communities of Indian Creek near 002 Outfall at Indian Creek Kilometer (INK) 0.2 and INK 2.2 consisted of 21 and 15 species, respectively. The Index of the Biotic Integrity (IBI) scores rated the sampling locations as poor (INK 0.2) to poor-fair (INK 2.2). The IBI is an analytical tool to generate qualitative scores using 12 standardized metrics. Each metric measures a particular aspect of the community (i.e. number of species, number of intolerant species) as compared to an ideal community. At INK 0.2, the poor rating is attributable to the abundant green sunfish (tolerant), lack of top carnivores and insectivorous cyprinids (e.g., sunfish). INK 2.2 scored poor-fair primarily due to the abundance of sand shiner and the low numbers of green sunfish. Of special interest in Indian Creek is the abundance of two particular species; green sunfish and central stonerollers. Each of these species are indicative of impacted watersheds. The central stonerollers are normally very abundant in nutrient rich, open canopy streams impacted by channelization. Green sunfish also are commonly abundant in these streams, but in addition, are common in thermally stressed streams or streams which have elevated temperatures on average throughout the year.

The ORNL study concluded that overall, the fish communities identified in Indian Creek and Blue River are typical of urban/industrialized watersheds. Based on direct measurements, the fish community appeared similar both upstream from and within the study area, indicating that discharges from the facility are not impacting the fish community (though the system as a whole may be affected by the urban environment within which it resides).

The potential for effects on the fish community can also be examined with respect to fish tissue PCB data. Niimi (1996) concluded that PCB tissue concentration of >50 to 100 mg/kg in fish may be required to adversely affect growth and reproduction in these organisms. The maximum wholebody[2] PCB concentrations in fish tissue in Indian Creek and Blue River measured in any of the field investigations since 1991 is about 11.7 mg/kg, and average less than 1 mg/kg (concentrations in fish tissue are discussed in greater detail in the ecological exposure assessment section of this document). The relevance of the fish community in the selection of assessment endpoints is discussed further in Section V.D.2.1.4.

Substrate-Associated Communities

From the standpoint of ecological relevance, the stems and foliage of **aquatic plants** constitute natural "free" surfaces used by aufwuchs-type organisms (see below), and they also provide shelter for a variety of other invertebrates, fishes, and certain semiaquatic animals (especially adult insects and birds). Macrophyte beds serve as "nursery" habitat for small juvenile fishes.

[2] Wholebody fish tissue concentrations were largely project from fillet data.

Moreover, the plants themselves are edible and provide forage for a variety of aquatic and semiaquatic herbivores (e.g., snails, muskrats) and omnivores (e.g., certain ducks). When they die, aquatic macrophytes contribute to the vegetative detritus in the system. Finally, rooted plants help stabilize shorelines and littoral sediments by moderating localized turbulence in the water column and presenting physical barriers, thereby, reducing erosion and turbidity. As a result of the variety of functions they provide, including food, shelter, and nursery habitat, aquatic macrophytes are considered important components of the ecological community. However, from the perspective of the COPECs at issue (*i.e.*, PCBs), aquatic macrophytes are much less sensitive than other organisms such as benthic invertebrates, birds and mammals. Therefore, though plants are considered an important component of the Indian Creek/Blue River system, they were not evaluated as part of the ERA. Concentrations of PCBs protective of invertebrate and tetrapod communities are also protective of plants.

The **aufwuchs[3] community** consists of a heterogeneous assemblage of algae, bacterial mats, and invertebrates associated with "free" surfaces as opposed to bottom substrates. Since many invertebrate animals are specifically adapted to such habitats (e.g., the crawling or "clinging" forms of insect larvae), the aufwuchs can contribute to the overall taxonomic diversity of any aquatic system. Many omnivorous or insectivorous fishes, often referred to as "grazers" or "browsers," tend to feed preferentially on aufwuchs-type organisms when available (e.g., some minnows, mosquitofish, some sunfishes). Most anglers are aware that submerged or emergent "structure" is much more productive, from the fisherman's perspective, than open water. It is not only the cover but also the food (e.g., aufwuchs) that attracts fish to "structure." Based on visual observations of Indian Creek in June 2000, there is a rich substrate of filamentous algae, probably as a result of nutrient enrichment from the upstream waste water treatment plant (WWTP). The algae, as with the vascular plants, are comparatively less sensitive than other organisms to PCB exposures. From a practical perspective, the invertebrate component of the aufwuchs community was not directly evaluated as an assessment endpoint, but was considered in the context of the benthic community.

In a broader sense, the **benthic community** includes both plants and animals, but for this study the more important components are likely to be invertebrate animals associated with the river substrate. The infaunal community in fine-grained sediments may include organisms such as oligochaete worms and dipteran insect larvae, and in some habitats, burrowing forms such as some mayfly larvae. In areas where firm or "hard" bottoms exist, there is likely an epifaunal component that includes snails and various crawling or clinging insect larvae; that is, many of the same types of invertebrates associated with the aufwuchs community. The substrate habitat of Indian Creek consists of rocks and gravel based on observations in June 2000, and is likely more conducive to the latter, whereas, the substrate of Blue River is more fine-grained sediments.

[3] The term "periphyton" is sometimes applied generically to this community, although it is also used in a variety of other contexts (e.g., as consisting only of plants, or as being associated only with plants as substrates). Therefore, the broader term "aufwuchs" is more appropriate for this document (Reid 1961).

The distinction between infaunal and epifaunal benthic invertebrates is important in assessing their relative susceptibility to exposures to medium-specific chemicals. Infaunal forms tend to be in more intimate contact with sediments and sediment pore water, and may have relatively limited exposures to substances dissolved or suspended in the overlying water column, whereas the reverse tends to be the case for epifaunal invertebrates. Although a valid generalization, the preceding statement has many exceptions. For example, some burrowing mayfly "nymphs" and some bivalve mollusks (e.g., Asiatic clams) are considered infaunal because they live "in" the sediment, but both are seldom in direct contact with the sediment or pore water because of behavioral and morphological adaptations (Fremling 1960; McMahon 1991). The more significant exposures to chemicals in these two examples would be via aqueous concentrations from the overlying water column rather than via bulk-sediment or pore-water concentrations.

As with fish, benthic invertebrate studies have been conducted on Indian Creek and Blue River (ORNL 2000). Consistent with the results of the fish studies, the macroinvertebrate communities of Blue River and Indian Creek were found to be representative of streams receiving nutrient enrichment from an urbanized watershed. In addition, channelization of the stream(s) also directly reduces the habitat diversity, which impacts the potential diversity of the benthic community. The macroinvertebrate communities of these streams consisted of moderately tolerant organisms that thrive in high nutrient, high silt-load conditions. The organisms most commonly found included the mayfly. *Baetis sp.*; the caddisfly *Cheumatopsyche sp.;* chironomids; riffle beetles *Stenelmis sp.*; oligochaetes, the damselfly *Argia sp.;* leaches and pond snails *Physella sp.* Several locations in the ORNL study were located directly in Indian Creek. Specifically, Indian Creek Kilometer (INK) 0.2 was located downstream from Outfall 002 and INK 2.2 was located upstream from Outfall 002. Location INK 18.5 was located upstream from INK 2.2 and Outfall 002 and immediately downstream from a sewage treatment facility. The furthest upstream sampling location was at INK 21.9. The ORNL study indicated the macroinvertebrate community at locations INK 0.2 (28 taxa), INK 2.2 (34 taxa), and INK 21.9 (35 taxa) had similar species composition. Species composition was reduced at location INK 18.5 (23 taxa). INK 18.5 also had mostly high pollution tolerance taxa such as chironomids (44%), *Physella* (17%), *Baetis* sp.(12%), and leeches (9%), whereas other locations in Indian Creek had more than 50% mayflies (especially *Baetis* sp.) and around 25% caddisflies (especially *Cheumatopsyche* sp.). In addition, the number of ET taxa (Ephemeroptera and Trichoptera) present at locations INK 0.2 and INK 2.2 was 7, but only 3 were identified at INK 18.5. ET taxa are pollution-sensitive species and are used as a comparative tool.

Overall, benthic macroinvertebrate data suggest that there are widespread moderate impacts in Indian Creek characteristic of an urbanized watershed. Though there appear to be impacts immediately downstream from the sewage treatment facility, the data do not indicate site-related effects on the benthic invertebrate community. The relevance of the benthic macroinvertebrate community in the selection of assessment endpoints are discussed further in Section V.D.2.1.4. Benthos may also act as transport mechanisms for ingestion pathway exposures of PCBs to higher level organisms.

Terrestrial and Semiaquatic Animals

The immediate areas surrounding Indian Creek and Blue River are relatively heavily vegetated and support a variety of human-tolerant species. Common tree species observed in an area reconnaissance in June 2000 were species such as cottonwood, box elder, willows, silver maple, elm, paw-paw and sycamore. Species such as oak and hickory were common on steep slopes above the creeks. Though within an urban watershed, and surrounded by urban/industrial development, there did not appear to be substantial "use" by people except at readily accessible areas where roads crossed or were located adjacent to the stream channels.

Border areas along the streams likely support resident populations and transient individuals of a variety of animal tetrapod vertebrates. The tetrapod vertebrates are herein collectively referred to as "wildlife," and include representatives of the classes Amphibia, Reptilia, Aves (birds), and Mammalia. Although many terrestrial invertebrates are ecologically important as consumers, prey for "higher" animals, and in some cases more esoteric functions such as pollination; the media of interest in conjunction with Indian Creek and Blue River are surface water and sediments. There are many aquatic or semiaquatic wildlife (particularly birds and mammals) that are important predators, and are also generally valued in an aesthetic if not economic context. Wildlife, as herein defined, encompass vertebrate groups that are all fundamentally "terrestrial" in the sense that at least their juvenile and adult life-stages are dependent upon access to (if not immersion in) air for respiration. However, from the standpoint of relative vulnerability to exposures to chemicals it is important to draw a distinction between the relative affinities for water as a source of food or cover. Therefore, a distinction was made between semiaquatic and strictly terrestrial (terrestrial) forms. Basically, semiaquatic animals were considered to include any vertebrates that tend to spend the bulk of their time in or near permanent waterbodies and tend to derive the bulk of their diet from aquatic sources (e.g., "piscivorous" or fish-eating forms such as the great blue heron). Extreme examples of semiaquatic vertebrates include most amphibians (salamanders and frogs) whose embryonic and larval stages require immersion for respiration to/from water via gills and/or skin. At the opposite extreme are animals that have behavioral affinities for permanent waterbodies, when accessible, as foraging areas, such as certain herons or swallows (birds) or the raccoon (a mammal). These semiaquatic animals represent a key focus for the ecological risk assessment of Indian Creek and Blue River because of the biomagnifying characteristics of PCBs. This is discussed further with respect to selection of assessment endpoints in Section V.D.2.1.4.

Deer, fox, raccoon, opossum, mice, rats, muskrats, beaver and suburban avian species (robin, starling, grackle, blue jay, cardinal and sparrows) have been observed in the riparian area adjacent to Indian Creek and the Blue River (ORNL 2000). In addition, kingfisher, and tracks of other piscivorous (fish eating) species such as heron, were observed in the June 2000 site reconnaissance.

Sensitive Receptors/Habitats

An important component of the ecological risk evaluation is to identify whether sensitive receptors or habitats are present in the study area that warrant special consideration. These include rare, threatened and endangered species, or habitats known or perceived to be worthy of special attention. As discussed in Section III.D.7, the Missouri Department of Conservation (MDC) and US Fish and Wildlife Service (USFWS) were consulted as part of the environmental assessment. MDC determined that no sensitive species or communities occur in the KCP area. USFWS determined that the only sensitive species that may be present in the area is the bald eagle. However, bald eagles are not expected to be associated with areas of Indian Creek and Blue River, since they are typically associated with larger bodies of water.

V.D.2.1.2 Ecological Exposure Pathways

Broadly defined, exposure pathways include direct contact (i.e., dermal) and ingestion pathway exposures. Direct exposures are defined as direct contact between a medium of interest and a receptor. Examples include roots of vegetation or invertebrates in direct contact with soils or sediment; or fish, amphibians or invertebrates in direct contact with surface water.

Potential exposure pathways for vertebrate receptors include: (1) inhalation, dermal contact and direct ingestion of environmental media; and/or (2) ingestion of dietary items containing chemicals as a result of bioconcentration/accumulation (i.e., food chain exposures). Because volatile organic chemicals are not of interest at the study area, and because this is an aquatic environment, inhalation exposure was not considered a significant exposure pathway and was not considered in the overall evaluation. "Direct" dermal contact with sediment is a potentially complete pathway to some fish, reptiles and amphibians. This could be a particularly important pathway for some organisms that burrow in the sediments to escape predators or wait in search of prey (such as some turtles). However, there is little ecotoxicological information on the dermal toxicology of ecological receptors in aqueous media. Direct dermal contact to surface water is also a potentially complete pathway. However, as indicated previously, PCBs have not been detected in surface water of Indian Creek.

It was noted earlier that fish and benthic macroinvertebrates would not be evaluated as assessment endpoints in the ERA because stream studies indicated that community composition was affected by the urban environment in which the streams reside, but that structural community changes could not be attributed to point source discharges such as that associated with KCP.

The most significant uptake mechanism of PCBs for terrestrial (air-breathing) animals is via ingestion; therefore, the degree of accumulation in "wildlife" is determined by diet (Eisler 1986; Hoffman *et al.* 1996; Kamrin and Ringer 1996). Because of the lipophilicity and propensity of PCBs for bioaccumulation and biomagnification, tertiary and quaternary consumers among the semiaquatic vertebrates("top carnivores") that tend to feed preferentially on fish and/or benthic macroinvertebrates are expected to be the most vulnerable to dietary PCB exposures.

V.D.2.1.3 Fate and Transport

The migration and persistence of a COPEC within the aquatic environment is controlled by the physical/chemical attributes of the COPEC, the physical/chemical attributes of the system (i.e., its limnology), and finally by the organisms and biological processes within the system. All of these attributes alter the ultimate fate of the COPEC, and their interaction is highly site-specific.

Certain generalizations can be made, however. This subsection reviews the following in general terms:

- The physical/chemical attributes of PCBs in the context of fate and transport (e.g., lipophilicity, solubility, and sorption phenomena);
- Relative importance of volatilization, photolysis, hydrolysis, and biodegradation as transport/transformation processes for PCBs, and
- Identification of those processes expected to be the most important for PCBs in the context of site-specific attributes.

Physical/Chemical Properties of PCBs

Migration (including bioavailability) and persistence of PCBs in the aquatic environment are controlled by: (1) physicochemical properties; (2) physicochemical attributes of the system (i.e., its limnology); and (3) the organisms and biological processes within the system. All of these factors alter the ultimate fate of PCBs, and the interaction is site-specific. The physical/chemical properties of PCBs are discussed in Section III.B.2.b.

A key property affecting the environmental behavior of an organic chemical is its comparative solubility in water and octanol. The ratio between concentrations in water *versus* octanol is represented by the octanol-water partitioning coefficient, the K_{ow} ($\log_{10}K_{ow}$). The K_{ow} of a chemical is a useful indication of its: (1) lipophilicity or propensity for sequestering into lipid ("fat") stores within living organisms; (2) propensity toward adsorption onto organic carbon; and (3) ability to cross biological membranes. Empirical relationships between a chemical's K_{ow}, water solubility, organic carbon partitioning coefficient (K_{oc}), bioconcentration factor (BCF), and assimilation coefficient for aquatic organisms are widely-used in predicting the behavior of organic chemicals (see Spacie *et al.* 1995 for a review). The concept of *fugacity* (Mackay and Paterson 1981) unifies the parameters K_{ow}, K_{oc}, and a chemical's Henry's Law constant to assist in predicting the relative partitioning of the chemical among six major matrices of a simple aquatic system. It is important to note that what are predicted are the relative masses expected in the respective matrices (or "compartments"), which are not necessarily representative of environmental concentrations. These values assume no advective transport and consider no degradation mechanisms. Additionally, these ratios are predicted under "steady-state" conditions (i.e., unchanging system dynamics). Such a situation never actually exists in nature, but the fugacity concept is still an effective tool for illustrating the expected behavioral tendencies of a COPEC based on its fundamental chemical properties.

The sorption process is a dominant factor for PCBs. This process has a direct bearing on the ERA as it impacts exposure pathways and especially the bioavailability. The process and/or degree of sorption with organic carbon, whether particulate or dissolved, has been shown to reduce the apparent (effective) bioavailability of both organic and inorganic compounds (Knulst 1992; Dewitt *et al.* 1992; Goodrich *et al.* 1992). Most sorption studies used to estimate or calculate partitioning coefficients for organic chemicals involve short exposure periods (hours to days) followed by desorption periods (EPA 1986). These studies have been performed, for the most part, under the assumption that the sediment sorption process follows first-order thermodynamic kinetics. DiToro (1985), Landrum *et al.* (1992), USACE (1992), and others have shown that this assumption is invalid. Sorption is more accurately described as a biphasic process, in which the initial phase involves the chemical sorbing onto the surface of a sediment particle, followed by a second phase in which the chemical is absorbed into the particle. This biphasic process has a greater impact on predictions of desorption than adsorption, since the contribution of the secondary absorption of a chemical within sediment particles does not have a great influence on the overall mass or concentration. Desorption, however, can be greatly overestimated since contact time and "degree" of adsorption will affect the rate of desorption (Landrum *et al.* 1992; USACE 1992, 1995). There is evidence that, given sufficient time, desorption essentially will not occur (Karrickhoff and Morris 1985b; DiToro 1985). This phenomenon is reflected in several recent articles which demonstrate reduced bioavailability (and toxicity) with the "age" of contamination in sediments (e.g., Landrum *et al.* 1992; Harkey *et al.* 1994, 1995).

An uncertainty in the prediction of bioavailability of sediment-associated PCBs is the inherent assumption of the equilibrium partitioning (EqP) approach that sorption of organic chemicals is dominated by the total organic carbon (TOC) content of the sediment. In fact, pore-water concentrations of dissolved organic carbon (DOC) also have a significant impact on the apparent bioavailability predicted by EqP (Williams *et al.* 1995).

Site-specific variables associated with the biodegradation of organic compounds have been compiled by Lymann (1995) and placed into three major categories: (1) substrate-related; (2) organism-related; and (3) environment-related. Substrate factors involve the concentration of the chemical in relation to a toxicity threshold and the physical form (i.e., whether it is accessible to the microbes). There are several factors associated with the organisms, perhaps the most important being prior exposure (acclimation). Microbial populations quickly adapt to environmental conditions, and those exposed previously will degrade organic compounds at a much greater rate than a population not adapted to the presence of the organic. Environmental factors include system temperature, pH, oxygen concentration, and salinity (TDS), as well as the concentrations of nutrients and electron acceptors (Lymann 1995).

Brief overviews of the environmental behavior of PCBs, emphasizing potential bioavailability and other factors immediately relevant to endpoint development, are presented in the following subsections. In the present context *bioavailability* refers to the fraction of the total concentration PCBs in environmental media that are potentially available for biological action, such as uptake by an aquatic organism (i.e., "environmental bioavailability;" Spacie *et al.* 1995)[4]. Uptake by organisms, or *bioaccumulation*, refers to accumulation via all possible mechanisms, such as direct absorption via gills or other tissues in contact with the physical media and the indirect process of ingestion. A key consideration for PCBs is the propensity for *biomagnification*, which is the tendency for increase in tissue chemical residues at higher trophic levels, mainly due to dietary exposures (Spacie *et al.* 1995).

[4] In pharmacology/toxicology "bioavailability" refers to the fraction of an administered dose that reaches target sites within an organism (Spacie *et al.* 1995).

PCBs are synthetic organic compounds based on biphenyl "rings," produced by chlorination in the presence of iron filings or ferric chloride as a catalyst (Hutzinger *et al.* 1974; Safe 1984; Sawhney 1986). The chlorination process results in mixtures of chlorobiphenyls, or congeners, which are influenced by the ratio of chlorine to biphenyl. In the U.S., these complex mixtures were manufactured under the trade name Aroclors®. The most common Aroclors, in general, included preparations such as 1242, 1248, 1254, and 1260, which have become the basis for reporting the results of gas-chromatographic (GC) analysis under SW-846 Method 8080/8081/8082. In the coding system used for the Aroclor preparations, the first two digits are the number of carbon atoms in the biphenyl group and the last two digits represent the approximate percentage of chlorine. Most of the individual chlorobiphenyls are solids at room temperature, but the Aroclor preparations (in their original, purified state) are generally resins or viscous fluids.

The "Aroclors" reported in environmental media are only rough approximations of the mixtures of congeners actually present (Cairns *et al.* 1986). This is due to a combination of factors, which include "weathering"[5] and metabolism in the environment as well as through the separation, extraction, and cleanup processes involved in the analytical procedures.

Notwithstanding the confounding influences of transformation in detailed analyses, the PCBs "are among the most stable organic compounds known" (Sawhney 1986). They can undergo incomplete photolysis, hydrolysis, and volatilization, but only to the extent that they are not sorbed to solids. Biodegradation occurs under both aerobic and anaerobic conditions, but is generally most significant in aerobic, acclimated microbial populations (Furukawa 1986; Lyman 1995). Rates of PCB biodegradation differ widely due to variations in microbial composition, nutrient concentration, other environmental factors (e.g., temperature), and the degree of chlorination. The "heavier" PCB congeners, such as those predominating in mixtures like Aroclor 1254 and 1260 (i.e., with 4 or more chlorines), are extremely recalcitrant to biodegradation (Furukawa 1986).

Solubility of PCBs in water generally decreases with an increase in the degree of chlorination. The individual congeners vary in their aqueous solubilities from about 6 ppm for some monochlorobiphenyls to as low as 0.007 ppm for octachlorobiphenyl (Hutzinger *et al.* 1974; Sawhney 1986). Behavior of PCBs in aquatic systems and their partitioning to different compartments is dominated by sorption, so that most of the mass is inevitably associated with solids (EPA 1980a; Sawhney 1986). Generally, the sorption of PCBs increases with increase in chlorine content, as well as with the surface area and organic carbon content of the sorbent. Not only are the higher-chlorinated congeners sorbed in greater quantities but they are also held more tightly on sorbent surfaces (Sawhney 1986).

[5] Weathering refers to a skewing in the basic composition of a mixture due to the differential rates of transformation (e.g., volatilization, sorption, hydroxylation, biodegradation) among the various congeners. For example, the mono- and dichlorobiphenyls tend to degrade faster than higher-chlorinated groups such as the penta- and hexachlorobiphenyls (Furukawa 1986).

Although relatively insoluble in water, PCBs readily dissolve in nonpolar organic solvents and in biological lipids (EPA 1980a). As a consequence of their lipophilicity, PCBs absorbed directly or indirectly by organisms tend to become sequestered in the adipose (fatty) tissues, where the PCBs generally tend to be less susceptible to mobilization and metabolism. This contributes to the relative persistence or longer biological half-lives of PCBs, particularly the higher-chlorinated congeners (Shaw and Connell 1986a; Niimi 1996).

PCBs are generally regarded as highly bioaccumulative substances (EPA 1979. 1980a; Waid 1986; Eisler 1986). This refers to the fact that PCBs are accumulated to some degree by virtually all types of organisms which come in contact with physical media containing the compounds. Uptake by aquatic organisms can be by absorption through gills and skin as well as (for many animals) ingestion of contaminated media (Shaw and Connell 1986a, b). The relative importance of uptake mechanisms varies substantially among groups of organisms, as a function of their morphology, physiology, and, especially, behavior (i.e., microdistribution in relation to the contaminated media). Uptake by plants obviously can only be via direct absorption. Generally, it is believed that for most strictly-aquatic animals (especially the structurally-simpler invertebrates) the dominant mechanism is absorption through gills or analogous "respiratory surfaces" (Shaw and Connell 1986a). In more complex invertebrates, fish, and larval amphibians (tadpoles) uptake via ingestion increases in relative importance and is believed by many to be dominant (Niimi 1996).

As noted previously, the most significant uptake mechanism for terrestrial (air-breathing) animals is via ingestion; therefore, the degree of accumulation in "wildlife" is determined by diet (Eisler 1986; Hoffman *et al.* 1996; Kamrin and Ringer 1996). Because of their lipophilicity and general resistance to mobilization/metabolism within biological tissues, PCBs are classic examples of biomagnifiers (Shaw and Connell 1986b).

Ecotoxicology of PCBs

There are 209 PCB congeners among the PCBs, but fewer than half are expected to be of toxicological significance due to extremely low abundance and/or molecular structure (Hutzinger *et al.* 1974; Niimi 1996). Aroclors are complex mixtures of chlorobiphenyls and are capable of a variety of toxic effects. There are substantial differences among the observed toxicities as well as among organisms exposed to the same Aroclor.

Growth (cell division) and photosynthesis in plants can be affected by PCBs. Although some marine diatoms appear sensitive to dissolved PCBs (EPA 1980a; Manhanty 1986; Niimi 1996), the levels of concern for freshwater are well above the detection limit of 1 part per billion (ppb) (Urey *et al.* 1976; Christensen and Zielski 1980). In terrestrial vascular plants PCBs tend to disrupt normal control over growth that is believed to be associated with interference with photosynthesis and cell division. However, indirect toxicity may be associated with effects on plant transpiration. Vascular plants are fairly resistant to PCBs with effects manifested in the range of 20-200 parts per million (ppm) (Manhanty 1986).

Adverse effects on reproduction, growth, and development in a few aquatic invertebrates and fishes have been associated with sub-ppb waterborne concentrations (EPA 1980), but in general these effects are elicited at aqueous concentrations >1 ppb (usually >10 ppb) or tissue levels in the organisms >25 ppm (Niimi 1996). The ability of lower trophic level organisms to accumulate PCBs to tissue levels in the ppm range gives rise to the main concern regarding chlorobiphenyls since this is associated with dietary exposures to higher-level consumers. Egg hatchability was reduced when chickens were fed various diets containing 20 ppm of various PCB Aroclors (1232, 1242, 1248 or 1254), and reproductive impairment in chicken was recorded at Aroclor dietary levels as low as 5 ppm (Heinz et al. 1984). Other birds evaluated in feeding experiments have been somewhat more resistant (i.e., dietary levels in the hundreds or even low thousands of ppm; Hoffman *et. al.* 1996). Adverse effects on reproduction in chickens have been associated with diets containing as little as 5 ppm Aroclor 1254; however, experiments with other birds (even other groups of chickens) and other PCB mixtures suggest that the dietary threshold for significant reproductive impairment is probably >10 ppm (Peakall 1986; Hoffman *et al.* 1996).

Mammals in general tend to be slightly more sensitive to PCBs than birds (Eisler 1986a; Kamrin and Ringer 1996). As with birds, however, there appears to be a wide range of sensitivity depending upon the mammalian species and the form of PCBs ingested. Although mink appear to be extremely sensitive to certain congeners and congener mixtures, the European ferret, a very closely related species, is relatively resistant (Ringer 1983). Survival in mink has been affected by experimental diets containing as little as 6.7 ppm Aroclor 1254 (Ringer 1983), and reproductive impairment in both mink and small rodents has been experimentally demonstrated in diets containing as little as 5 ppm Aroclor 1254 (Aullerich and Ringer 1977; McCoy *et al.* 1995).

The underlying mechanism(s) for PCB toxicity has not been clearly established, but the most significant chronic effects in birds and mammals are related to reproduction (Hoffman *et al.* 1996; Kamrin and Ringer 1996; EPA 1997a).

V.D.2.1.4 Selection of Assessment Endpoints

Among the crucial products of problem formulation are assessment endpoints, which provide a bridge between broad management or policy goals (e.g., "protection of the environment") and the specific measurements used to evaluate risk in the assessment. Clearly-defined assessment endpoints provide direction and limits for the investigation. "An assessment endpoint is the explicit expression of an environmental value that is to be protected" (EPA 1992, 1997, 1998). Two elements are needed to define an assessment endpoint: (1) the valued ecological entity (e.g., a local population of a species, a functional group of species); and (2) the property or attribute of that entity which is potentially at risk and important to protect. This section integrates the information on the ecosystem, the nature and extent of contamination, and the environmental chemistry and toxicity of PCBs to identify assessment endpoints. First, the valued ecological entities and properties are identified. These are then considered in conjunction with the environmental behavior and relative toxicity of PCBs, (i.e., the most sensitive types of receptors with the greatest potential for exposure) to ultimately focus upon selection of the assessment endpoints that are relevant to the ecological risk assessment of Indian Creek.

In ecological risk assessment, three levels of biological organization are generally recognized as important: populations, communities, and ecosystems (EPA 1989a, 1992, 1996b, 1997; Suter 1993). There is no broadly-accepted approach for determining which of the numerous ecological entities that fall under these levels of organization are "values" that are important, either regionally or at specific locations. However, a consensus has emerged that relevance (significance) can be defined in terms of the properties of ecological entities that are necessary to *sustain the natural structure and function of an ecosystem* (EPA 1998). Collectively, such properties are most appropriately referred to as either *sustainability* or *integrity*.

Biological communities of Indian Creek and Blue River were characterized in Section V.D.2.2.1. Ecologically relevant communities in Indian Creek relevant to this ERA include fish, benthic macroinvertebrates, and semiaquatic birds and mammals.

With respect to direct exposures to benthic macroinvertebrates, consensus-based sediment effect concentrations for PCBs in freshwater sediments were published in 1999 (Macdonald et al. 1999), as follows:

Threshold Effect Concentration	0.035 mg/kg
Midrange Effect Concentration	0.34 mg/kg
Extreme Effect Concentration	1.6 mg/kg

PCBs have been detected in a small stream segment in immediate association with the Outfall 002 discharge, ranging in concentration from 0.48 to 2.3 mg/kg. At about 100 m downstream from this location, and in all other sediment sampling locations within Indian Creek and Blue River, PCBs have not been detected (reporting limit 0.1 mg/kg). One-half the detection limit approximates the threshold effect concentration. It is concluded that PCBs concentrations are insufficient to suggest potential risks to the benthic macroinvertebrate community in Indian Creek or Blue River, with the exception of the immediate vicinity of the Outfall 002 discharge. Potentially localized suppression of the benthic macroinvertebrate community in this small area is not considered significant from a biological or population-level perspective.

Taking into consideration the biomagnifying characteristics of PCBs, the rationale for selection of assessment endpoints for PCBs is succinctly expressed as an example in ERAGS:

> The primary ecological threat of PCBs in ecosystems is not through direct exposure and acute toxicity. Instead, PCBs bioaccumulate in food chains and can diminish reproductive success in some vertebrate species. PCBs have been implicated as a cause of reduced reproductive success of piscivorous birds (e.g., cormorants, terns) in the Great Lakes (Kubiak et al. 1989; Fox et al. 1991) and of mink along several waterways (Aulerich and Ringer 1977; Foley et al. 1988). Therefore, reduced reproductive success in high-trophic-level species exposed via their diet is a more appropriate assessment endpoint than either toxicity to organisms via direct exposure to PCBs in water, sediments, or soils, or reproductive impairment in lower trophic-level species.

Furthermore, focusing on the higher-trophic level species is warranted based on the existing information with respect to the fish and benthic macroinvertebrate communities. Specifically, PCBs have not been detected in surface water of Indian Creek or Blue River (reporting limit = 0.1 ug/L), and except for a very localized portion of Indian Creek (less than 100 m in length), PCBs have not been detected in sediments of Indian Creek or Blue River (reporting limit 0.1 mg/kg). In addition, concentrations of PCBs in fish tissue (less than 1 ppm) are below levels reported to result in effects of survival, growth or reproduction (>50 ppm). Assuming concentrations of PCBs in invertebrates are comparable to or less than concentrations of PCBs in fish (i.e., less than 1 mg/kg), the PCBs in invertebrates are below levels reported to result in effects to the benthic macroinvertebrate community (>25 ppm). This is believed to be a reasonable assumption, since PCBs biomagnify, and fish are at a higher trophic level than the food they consume (i.e., invertebrates). This is also supported based on results of other field investigations. For example, collocated fish and benthic data reported in EPA (1999) and from areas consistent with the range of sediment PCB concentrations observed in Indian Creek are presented in the attached table (Table 5.57). The average ratio of the PCB concentration in benthos to fish was 0.74.

Finally, a report of fish and benthic community health submitted to MDNR (ORNL 1999) concluded there are no effects on the fish or benthic community associated with the Outfall 002 discharge. Based on existing information for Indian Creek and guidance provided by ERAGS, the following assessment endpoints were selected for the ERA of Indian Creek and Blue River:

> *Survival, growth and reproduction of semiaquatic invertebrate consumers* – These consumers ingest invertebrates that are (at some stage in their lives) in intimate contact with sediments, and as are result, may have accumulated PCBs.
>
> *Survival growth and reproduction of semiaquatic carnivores* – These organisms become increasingly important in terms of biomagnifying chemicals.

These assessment endpoints are further specific to birds and mammals, and do not include amphibians and reptiles. This is not intended to indicate that amphibians and reptiles are not ecologically relevant, but rather, it is based on the practical limitations of available ecotoxicological data. For ingestion-pathway exposures, little to no oral toxicity data are available for amphibians or reptiles for most chemicals. Though there may be adequate knowledge of an animal's behavior and physiology to estimate exposures with reasonable accuracy, it is of limited practical value to do so if there is no basis for evaluating the consequences of the exposures. Thus, the importance of exposures to these organisms represents an uncertainty in the risk evaluation.

Ecological Receptors of Concern (ROCs)

To develop a measurement by which the assessment endpoint may be tested, an applicable ecological component is identified that is representative of the assessment endpoint. For ingestion pathway exposures associated with higher vertebrates the generally accepted approach is to select indicator species (EPA 1997; 1998), that are referred to herein as *receptors of concern* (ROCs). ROCs are selected because toxicity reference values (TRVs) used for comparing environmental exposures to potential effects are species-specific. Therefore, ROCs were selected that are characteristic of the ecosystem, and representative of the assessment endpoint. The following were taken into consideration in the selection of ROCs:

- Probable intensity/duration of exposure. In general, species were selected that are known or anticipated to be relatively common and abundant in and around the study area. Given a choice between an infrequent or seasonal immigrant and a year-round resident, the latter received preference.
- Availability of relevant behavioral and physiological data. In general, preference was given to relatively well-studied species for which most biological attributes are readily accessible. When appropriate, for example, candidate receptors were selected from among those covered in the *Wildlife Exposure Factors Handbook* (EPA 1993b).
- Availability of relevant toxicological data. For ingestion-pathway exposures, virtually no oral toxicity data are available for amphibians or reptiles. Therefore, amphibians and reptiles were not selected as receptors, as indicated previously.

Other considerations are relative sensitivity or species warranting special consideration. In addition, size serves as an "index" to behavioral and physiological differences that may influence the animals' susceptibility (and sensitivity) to chemicals. Smaller animals tend to be shorter-lived, occupy smaller home ranges (and occur in greater densities), and have higher metabolic rates. Therefore, when multiple potential receptors of similar attributes in terms of trophic structure, guild, and relative sensitivity were available as potential candidate receptors, the smaller receptors were generally selected in preference to, or in addition to, larger receptors.

Insectivorous and carnivorous birds and mammals were identified as assessment endpoints. Insectivores will be exposed to PCBs since emergent insects, in their pre-emergent stages, are directly exposed to surface water and sediments. Because PCBs biomagnify, carnivorous birds and mammals, particularly piscivores (fish-eating) will be subject to the greatest PCB exposures.

Insectivorous birds include swallows and sediment probing shorebirds. Swallows are aerial screeners and some species, such as tree swallows, feed over open water on emerging insects which have potentially been exposed to contaminated sediments. Swallows are seasonally-occurring species and do not overwinter in this area, but they are colonial and have relatively small territories that can potentially concentrate these birds over small areas. Thus, tree swallows are of interest because of their high potential for exposure. Among mammals, one of the few true invertebrate consumers that may be closely associated with aquatic environments is the bat. Because of their small size, bats have a high metabolic rate that may result in higher exposures due to high consumption relative to body weight. The little brown bat was selected as a ROC because it often feeds on emergent insects over water.

Probably the most common large semiaquatic carnivorous bird associated with the area is the great blue heron. The great blue heron is a resident in the vicinity of the site and is very territorial, especially during the nesting season. Although often simplistically referred to as fish-eating, or piscivorous, great blue herons actually consume a wide variety of aquatic, semiaquatic, and terrestrial prey animals. For the purposes of the evaluation of Indian Creek and Blue River, it was assumed that the entire diet consisted of fish. Kingfishers represent smaller semiaquatic carnivorous birds. Being smaller than the heron, the kingfisher has a higher metabolic rate and will ingest a greater amount of food relative to its body weight, though like the heron, they are not strictly piscivorous. They tend to establish a few "preferred perches" along a given stretch of shoreline, and generally feed in deeper water than the heron. Kingfishers have little or no contact with the sediments whereas the heron, because of its feeding habits, will incidentally ingest sediment. There are prevalent perches along Indian Creek for feeding, and exposed banks which are used for nesting. As a result, the exposure (expressed as mg/kg-day) may be greater. Therefore, both the great blue heron and the kingfisher are selected as representative receptors for evaluation of PCBs among predominantly piscivorous birds.

Among carnivorous mammals, the mink was selected as a ROC. The raccoon, another semiaquatic mammal, is believed to be common along Indian Creek based on the prevalence of tracks observed along the creek during a site reconnaissance in June 2000. However, the raccoon is largely an omnivore, whereas the mink is a strict carnivore. The mink also has a small body weight (and relatively high ingestion rate), and are also known to be sensitive to PCBs. The overall suitability of the habitat to mink may be somewhat questionable due to the surrounding urban area. However, the region along Indian Creek is believed to be sufficiently buffered, and provided with vegetated corridors along both Indian Creek and Blue River, to support mink. A summary of the ROCs is provided in the following table.

RECEPTORS OF CONCERN

Assessment Endpoint	Receptor of Concern	Rationale
I. Survival, growth, and reproduction of semiaquatic invertebrate consumers		
Bird	Tree Swallow	Both the bat and tree swallow forage on emergent aquatic insects over water. In a pre-emergent stage, these insects may be directly exposed to PCBs in sediments and surface water.
Mammal	Little Brown Bat	
II. Survival, growth, and reproduction of semiaquatic carnivores		
Bird	Great blue heron Banded kingfisher	Both birds are believed to be present at or near the site, and are largely, though not exclusively, piscivorous. The great blue heron can establish relatively small feeding territories. Feeding perches and breeding areas are prevalent for the kingfisher. Kingfishers have smaller bodies, which results in higher exposures because of higher feeding rates relative to body weight.

RECEPTORS OF CONCERN		
Assessment Endpoint	**Receptor of Concern**	**Rationale**
Mammal	Mink	Mink have small bodies, are voracious predators, and are particularly sensitive to PCBs.

V.D.2.1.5 Ecological Risk Analysis

Risk analysis is the process by which the assessment point is evaluated. The process requires: (1) the distribution of the COPEC in exposure media (e.g., sediment, water, and food) specific to a ROC along with an understanding of the measures of receptor characteristics (Exposure Assessment); and (2) a credible literature-based toxicological effect level (Effects Assessment). The measure of effect in this desktop evaluation is a comparison between the dose the candidate receptor receives (the environmental exposure concentration, EEC) and a literature-derived toxicity reference value (TRV). The ratio between the TRV and the EEC is termed the ecological effects quotient (EEQ).

Exposure Assessment

To realistically characterize exposures it is necessary to account for the spatial variation in COPEC concentrations as well as distributional attributes of the receptors (i.e., measures of exposure and receptor characteristics). The assessment endpoints selected for this ERA are based on ingestion pathway exposures. Meaningful inferences about the potential hazards of ingesting PCBs requires an understanding of the relationship between exposures, expressed as *doses* or rates (i.e., mass of PCB/unit of receptor body weight/unit of time), and *responses*. Doses are estimated using:

- The measured and/or predicted concentrations of PCBs in media known or assumed to be ingested (i.e., food, water, sediment, and soil); and
- Estimates of the mass of PCB consumed per day, obtained by multiplying the concentration (mg/kg or µg/L) in a medium by the amount of that medium (kg or L) assumed to be ingested by an individual in the population of the receptor species and expressed in terms of the mass (body weight) of the receptor (mg/(kg-day).

Ingestion-pathway exposures to the vertebrate ROCs were estimated as *average daily doses* using the approach outlined in EPA (1993a) as follows:

$$(1) \qquad ADD = [(IR_{food}*C_{food}) + (IR_{water} * C_{water}) + (IR_{sed}*C_{sed}) * AUF/BW$$

where:

ADD = Average Daily Dose (mg/kg/day)

IR_{food} = Ingestion rate of food (kg/day)

IR_{water}	=	Ingestion rate of water in (L/day)
IR_{sed}	=	Ingestion rate of sediment in (kg/day)
C_{food}	=	Concentration of COPEC in food (mg/kg) =
		[(diet composition[6] $_{food1}$ * C_{food1})+(diet composition $_{food2}$ * C_{food2}) ... $food_n$]/100
C_{water}	=	Concentration of COPEC in water (mg/L)
C_{sed}	=	Concentration of COPEC in sediment (mg/kg)
AUF	=	Area use factor (decimal fraction)
BW	=	Body weight (kg)

The primary dietary components for the ROCs are fish and aquatic invertebrates. There are a number of data for PCBs in fish tissue in Indian Creek. Though the data are limited primarily to green sunfish and channel catfish, these species are representative of the types of fish species that may be preyed upon by piscivorous animals. A limitation for the majority of these data is that they are comprised predominantly of fillet analyses. Though fillets apply directly to human consumption, whole body data are necessary for evaluation of ecological receptors. With the exception of a few catfish captured in Indian Creek, which are based on wholebody data, it is necessary to estimate the concentration in wholebody tissue from the concentration in the fillet. This was accomplished by assuming that the ratio in the lipid content between wholebody tissues and filet tissue is representative of the PCB concentration ratio between wholebody tissues and fillet tissue. This is a reasonable assumption since PCBs are lipophilic compounds.

The ratio for catfish was derived from lipid concentrations reported in *The Incidence and Severity of Sediment Contamination in Surface Waters of the United States* (EPA 1997). The mean wholebody lipid concentration reported among 7,512 observations for channel catfish was 7.1%. The mean fillet lipid concentration reported among 20,655 observations was 5.1%. This suggests that the PCB concentration in wholebody is about 1.4 times that in the fillet.

Only wholebody lipid concentrations are reported in EPA (1997) for green sunfish: 3.6% among 376 observations. Though fillet lipid concentrations were not reported, there is a reasonably sizeable database on lipid concentrations in green sunfish fillets collected in Indian Creek and Blue River. These data are presented in Table 5.58. The average lipid concentration was 1.4% (n=164). This is comparable to that reported in EPA (1997) for the pumpkinseed sunfish, and suggests a wholebody lipid to fillet lipid ratio of about 3.6:1.4, or 2.6. A value of 2.6 was used to estimate wholebody PCB concentrations based on fillet data for Indian Creek and Blue River. Note that lipid concentrations vary by season and location, and are influenced by factors such as food supply, sex, breeding stage, etc. However, the number of observations used to derive lipid relationships are reasonably large, and likely contain samples derived among a variety of conditions that influence the variability in lipid concentration, and is probably a reasonable average. In the absence of site-specific wholebody data, these lipid relationships were used to estimate wholebody PCB concentrations from fillet data.

[6] Diet composition is input as a percentage of the overall diet. The sum of all should equal 100.

The area uses for the piscivorous ROCs range from 1.0 km (kingfisher) to 3.1 km (great blue heron). This is discussed in greater detail later in this section. The Area Use places a spatial component to the area in which fish tissue data should be averaged. For example, the first two fish sampling sites downstream from 002 Outfall were located at ICK 0.2 and BRK 27. Assuming that Indian Creek enters Blue River at about BRK 27.8, these locations are about 1 km apart. Other downstream fish sampling sites were located at BRK 26, BRK 25, and BRK 21, or about 2, 3 and 7 km downstream, respectively. For the purposes of estimating exposures to ROCs, the fish collected from ICK 0.2, BRK 27, BRK 26, and BRK 25 were pooled, and the 95% upper confidence limit on the mean calculated. A summary of the fish tissue data used for this ERA is provided in Table 5.59.

In fish tissue, only Aroclors 1248, 1254 and 1260 were detected. To calculate total PCBs, the sum of these three Aroclors was calculated, using one-half the detection limit for nondetect values. Data were first evaluated to determine if they were normally distributed or lognormally distributed. This was accomplished using the D'Agostino D-Test for datasets (since the dataset was larger than 50) (from Gilbert 1987). Based on the results of the data distribution, the following logic tree was used to select a method for calculating the mean and 95% UCL of the mean (EPA 1997b):

- If the data were normally distributed, the Student's *t* approach was used to develop the 95% upper confidence limit for the arithmetic mean of the dataset (EPA 1992b, 1997b).
- For lognormally distributed data, lognormal-theory-based formulas were used to compute the mean variance unbiased estimator (MVUE) of the population mean and standard deviation, and the 95% UCL of the mean was calculated with the jackknife method (EPA 1997b, Sokal and Rohlf 1981).
- If the data are neither normally or log-normally distributed, then the nonparametric version of the jackknife was used to calculate and 95% UCL.

Among the fish data collected for ICK 0.2, BRK 27, BRK 26, and BRK 25, there were 104 samples collected between 1992 and 1998. The data were lognormally distributed, so the MVUE and jackknifed UCL were calculated. The resultant mean concentration was 0.57 mg/kg, and the 95% UCL was 0.68 mg/kg. A computer printout of results is provided in Attachment 5.1.

The primary dietary item for the little brown bat and tree swallow are emergent aquatic insects. For the purposes of this evaluation, it was assumed that substrate (*i.e.*, sediment) associated benthic invertebrates emerge and are eaten by bats and swallows. As discussed previously, the concentrations in benthic invertebrates are expected to be lower than that of fish. This is believed to be a reasonable assumption, since PCBs biomagnify, and fish are at a higher trophic level than the food they consume (i.e., invertebrates). Data from EPA (1999) suggested a mean benthos:fish PCB ratio of about 0.74 in the Hudson River (Table 5.57). This is borne out by studies in other river systems as well. For example, Steingraber *et al.* (1994) noted that the concentration of PCBs in emergent mayfly nymphs was between that of common carp and sediments in the upper Mississippi River. In Indian Creek, the 95% UCL concentration in wholebody fish tissue (0.68 mg/kg) was used as a conservative estimate of PCBs in benthic invertebrates of Indian Creek.

An estimate of PCBs in sediments to receptors might be exposed was calculated using an area-weighted approach. Among sediment samples collected in Indian Creek and Blue River in 1998 and 1999, the only detections of PCBs were 0.48 mg/k and 2.3 mg/kg Aroclor 1242 near 002 Outfall (Sample location IC-8 in Figure 3.13 of RFI). At about 100 m further downstream in Indian Creek, PCBs were not detected (Sample location IC-9 in Figure 3.13 of RFI), nor were they detected further downstream in Indian Creek or Blue River. The area-weighting factor for estimating the exposure concentration is best evaluated in the context of the area uses of the ROCs. For example, the area use of a belted kingfisher is about 1 km, whereas that of the little brown bat is 12 km (Sample and Suter II 1994, Sample *et al.* 1997). Area uses for each of the receptors will be discussed later in this section. The average sediment concentration to which a specific receptor might be exposed can be expressed as a simple area-weighted value as follows:

$$\frac{0.1\text{ km} * 2.3\text{ mg/kg} + (\text{area use} - 0.1\text{ km}) * 0.0165\text{ mg/kg}}{\text{area use}} = \text{sediment concentration (mg/kg)}$$

where:

area use is the ROC-specific area use in km,

0.1 km is the area assumed to potentially contain detectable concentrations of PCBs.

2.3 mg/kg is the maximum concentration in the area containing measurable concentrations of PCBs (used in the absence of a sample number satisfactory for statistical evaluation of a 95% UCL).

0.0165 mg/kg is ½ the detection limit of Aroclor 1242 in sediments of 0.033 mg/kg

The above relationship applies only to the mink, since the incidental sediment ingestion rate of the other receptors was assumed to be negligible (Table 5.60). Assuming an area use of 1.85 km (Table 5.60) and the relationship above, the sediment PCB exposure concentration for the mink is 0.14 mg/kg.

The remaining component of the ADD is that from ingestion of water. Organisms consume water as part of their daily intake, and as a consequence can acquire a portion of a dose via water ingestion. PCBs are known to have been discharged from 002 Outfall, but have not been detected in Indian Creek or Blue River. For the purposes of the ERA, one-half the detection limit of 0.1 μg/L was used the PCB concentration used to derive a dose via water ingestion.

Measures of Receptor Characteristics

To estimate the ADD for ingestion pathway exposures, relevant information regarding the behavior and physiological attributes of potential receptors is also required. The following ingestion-pathway exposure factors (assumptions) have been identified for each of the potential terrestrial ROCs:

- Area use (km of stream length)
- Composition of the diet
- Rate of ingestion of food (kilograms/day; IR_{food})
- Rate of ingestion of water (liters/day; IR_{water})
- Rate of ingestion of sediment (kilograms/day, $IR_{sediment}$)
- Body weight (kilograms; BW)

These characteristics are summarized in Table 5.60. All of the foregoing were developed in the context of a hypothetical individual of a vertebrate consumer species representing the receptor group or guild. Relatively few empirical measurements of these attributes in wildlife species are available, and those that are available are often based on captive specimens. For these and many other reasons, *assumed* values for these attributes are uncertainty. Uncertainty can never be totally eliminated, but prudent application of well-documented information about the behavior and physiology of the receptors minimizes uncertainty. For this reason, EPA commissioned the compilation of the *Wildlife Exposure Factors Handbook* (EPA 1993a), which warns its readers that in any given ecological risk assessment it is crucial to apply site-specific or region-specific knowledge whenever possible. The assumptions used in this analysis are all based on formally-published information for the species, or plausible surrogate species. Generally-accepted principles and qualified-professional judgment are used to derive assumptions from relevant literature that could be representative of conditions in Indian Creek and Blue River.

Area Use

To account for the fraction of ingested media derived from a unit or area, behavioral information from the literature (such as home ranges or feeding territories) is considered in light of the relevant dimensions. For example, if a receptor is known to forage over a greater area than is available in a unit, its exposure potential is less than that of an alternate species which forages over a smaller area (similar in size to a unit). Area use, in km of stream length, for the ROCs is presented in Table 5.60. The area of interest may be conservatively expressed as the furthest distance downstream in which PCBs were detected in fish tissue, i.e., at least to BRK 21, about 7 km downstream from 002 Outfall. This is within the area use of all receptors with the exception of the little brown bat. However, this is not a completely accurate statement, since there are also concentrations of PCBs if fish in areas outside the influence of the 002 Outfall (i.e., upstream from 002 Outfall in Indian Creek and in Blue River upstream from the confluence with Indian Creek). Therefore, for the purposes of this ERA, it was initially assumed that the area use factor (the area use in relative to the area of interest) was equal to one.

Dietary Composition

In nature, the diets of most vertebrates vary considerably (Allee *et al.* 1951; Martin *et al.* 1951). Some have morphological, physiological, and/or behavioral adaptations which limit their ability to use certain broad categories of food. Hence we recognize herbivores, omnivores, and carnivores. Within these types there are some species which are *relatively* more specialized, such as piscivores, invertivores, detritivores, granivores, frugivores, and so forth. However, even these more specialized forms seldom subsist on a single species of forage or prey -- except during brief periods when a particular item is readily accessible (Allee *et al.* 1951). There is a wealth of anecdotal information in the literature regarding the food habits of most common North American birds and mammals. In general, however, there is a paucity of detailed quantitative dietary studies, and these relate primarily to localized populations of only a few species (EPA 1993a). One clear pattern is the tendency for most birds and mammals to be highly opportunistic within the constraints of their respective feeding adaptations. Thus, in the absence of direct observation, it is reasonable to assume that a given bird or mammal will "preferentially" feed upon the more available (i.e., abundant and accessible) items in a given time and place (Allee *et al.* 1951).

For assessment of ingestion-pathway exposures to a given receptor one would ideally have site-specific information upon which to base a representative diet, characterized in terms of percentages by weight of the various major components. Since site-specific studies of the food habits of the selected receptors in Indian Creek have not been performed, an appropriate breakdown of the diet for each species must be based on interpretation of the largely-anecdotal literature. This interpretation should be based on professional judgment, common sense, and an awareness of what forage and prey items are most available (or might be most available absent contamination) in the area. In the context of the evaluation of Indian Creek, relatively specialized receptors have been selected whose diets are relatively simple. For the purposes of this evaluation, the diet of the insectivores was assumed to consist entirely of aquatic invertebrates. The diet of the great blue heron was assumed to consist entirely of fish. As pointed out previously, the great blue heron's diet also consists of other items, such as invertebrates. Assuming fish comprise 100% of the diet is a conservative approach. Macroinvertebrates will have lower concentrations of PCBs than fish because of the bioaccumulative/ biomagnifying potential of PCBs. The relative concentrations of PCBs between fish and benthos was discussed previously.

For the diets of kingfisher and mink, an invertebrate component to the diet has also been included, as obtained from *Estimating Exposure of Terrestrial Wildlife to Contaminants* (Sample and Suter II 1994). This is an oversimplification since the mink (as well as the great blue heron), also ingest other organisms such as amphibians (frogs). Though there is some uncertainty, the assumption is believed to be reasonable since other potential dietary items (such as frogs) are likely to have comparable or lower concentrations of PCBs than fish because of similar or lower trophic level and/or lower lipid contents. Therefore, this is considered a reasonably conservative approach. Dietary composition breakdowns for the selected representative receptors are presented in Table 5.60.

Food Ingestion Rate (IR_{food})

There are three general sources of food ingestion rates for wildlife:

- expressions based on a percentage of body weight, derived from collective experience (including some empirical measurements) of researchers familiar with the types of animals in question;

- empirical measurements, usually obtained from a relatively small "sample" of animals fed *ad libitum* in captivity; and
- allometric equations based on a combination of empirical measurements from a wide variety of representatives of a category of animals and bioenergetic principles and theory (e.g., Nagy 1987; see also EPA 1993b).

To the extent they were available, empirical measurements were used preferentially over allometric relationships. In the absence of empirical measurements specific to the selected receptors, use of the allometric equations (*i.e.*, those developed by Nagy (1987) and reproduced in EPA 1993) is appropriate because these are widely-accepted, empirically-derived relationships. Food ingestion rates are summarized in Table 5.60.

Water Ingestion Rate (IR_{water})

Sources of water ingestion rates are similar to those noted previously for food. Empirical rates were used preferentially. In the absence of empirical measurements specific to the selected receptors, the applicable equations of Calder and Braun (1983; as reported in EPA 1993) were used to calculate the ingestion of water in liters per day. Water ingestion rates for the ROCs are shown in Table 5.60.

Sediment Ingestion Rate ($IR_{sediment}$)

Many higher vertebrates are known to ingest sediment, usually incidentally to feeding or grooming (EPA 1993; Beyer *et al.* 1994)[7]. The quantities are often a function of the animal's feeding habits; for example, some small mammals which feed extensively on the roots of emergent vascular plants (e.g., the muskrat) ingest relatively high amounts of sediment. Professional judgment has been used in interpreting reported rates, or extrapolating from surrogate species. The rate is normally estimated as a percentage of the overall diet, and then converted to mass/day. Sediment ingestion rates were assumed negligible for all receptors except the mink. The assumed sediment ingestion rates (IR_{sed}) are included in Table 5.60.

Body Weight (BW)

Body weight is an important factor because it is used in calculating other exposure assumptions when realistic direct measurements are not available (e.g., food and water ingestion rates). It is also necessary for calculating average daily doses (which are generally reported in milligrams per kilogram-body-weight per day). Assumed body weights for the ROCs are presented in Table 5.60.

[7] There are also some vertebrates which deliberately ingest soil, a phenomenon called geophagy. For example, white-tailed deer commonly lick or nibble exposed soil or rock surfaces to acquire trace minerals.

V.D.2.2 Effects Assessment

Several databases, in addition to the open literature, were consulted for compilation of the ecotoxicological summary of TRVs for PCBs presented within Attachment 5.2. These include the ECOlogical TOXcity database (ECOTOX); ASsessment Tools for the Evaluation of Risk (ASTER); the Hazardous Substances DataBase (HSDB); the Integrated Risk Information System (IRIS); the TOXicity NETwork (TOXNET, which includes MEDTECS); and the Registry of Toxic Effects of Chemicals (RTECS). U.S. Fish and Wildlife Service *Contaminant Hazard Series* synopses, RTI (1995), Oak Ridge National Laboratory technical reports (Sample *et al.* 1996), and available Agency for Toxic Substances and Disease Registry (ATSDR) *Toxicological Profiles*. These sources were used to provide the information necessary for selecting toxicity reference values (TRVs) to derive ecological effect concentrations and to more completely illustrate the nature of the potential toxicity associated with PCBs.

In accordance with specific assessment endpoints involving survival, reproduction, development, and/or growth for selected ROCs, a literature search was conducted for appropriate dietary toxicological endpoints. These include the lethal dose, the Lowest-Observed-Adverse-Effect Level (LOAEL), and the No-Observed-Adverse-Effect Level (NOAEL). The lethal dose, expressed, for example as the $LD_{50,}$ is the dose lethal to 50% of the test organisms over a specific exposure period. Another example, the LD_{lo}, is a reported dose that is capable of producing lethality. The LOAEL is the lowest dose that results in a statistically significant effect compared to a control. The NOAEL is the highest dose where there is no statistically significant difference from the control response.

Lethal dose values generally represent acutely toxic endpoints, although this must be examined in the context of the exposure duration and the test animal. For example, a lethal dose based on a 1- to 5-day exposure might be considered an acutely toxic response, whereas a lethal dose reported for 50 or 100 days might be considered a chronic response. Emphasis is placed on selection of chronic endpoints (i.e., NOAELs and LOAELs) or lethal doses over extended periods. Greater weight is be given to multi-day or multi-week studies rather than single-dose studies. Additional weight is placed on those assays performed during a "critical life-stage" such as during gestation, conception, and/or early development.

The general strategy for selecting (or deriving) a single LOAEL and NOAEL value as a TRV from among the many values reported in the literature was as follows:

- Where literature values were identified for the specific assessment receptor, the lowest LOAEL representing the assessment endpoint (survival, reproduction, development, and/or growth) was selected. For the NOAEL scenario, the highest NOAEL that did not exceed the lowest LOAEL was selected.
- Where values were not available for a specific assessment receptor (which is characteristic of the majority of literature values), values from surrogate receptors were used.
- In cases where NOAELs were reported, but LOAELs were not identified, the highest reported NOAEL value was used for deriving TRVs. In such an instance, a LOAEL was derived based on 10 times the NOAEL.

- If LOAEL and/or NOAEL data were not available, but lethal dose data were reported, an uncertainty factor (division) of 10 was applied to the lowest acute lethal dose to derive a LOAEL, or an uncertainty factor of 100 to derive a NOAEL. LD_{10}s were selected preferably over LD_{50}s. An uncertainty factor (division) of 10 was also applied to the LOAEL to derive a NOAEL. Note that lethal dose values were only used in the absence of LOAEL and NOAEL information.
- Weight was given to the duration of the study, as well as the toxicological endpoint. Preference was given to studies that were chronic or subchronic exposure versus single event or acute exposures. Where data were available for more than one dosing regime, chronic was selected first, subchronic second, and acute only if no other data were available. Critical life-stage tests also carried significant weight.
- Studies were considered based on the dosing regime. Intraparitoneal or intravenous studies were not used. Studies using gavage or oral intubation were not used when food studies were available.
- Measures of effect considered included survival, growth and reproduction. Endpoints specifically related to survival, growth and reproduction such as fetotoxicity or infertility were also considered. Effects such as carcinogenesis, liver damage, kidney function, sperm mobility, enzyme induction, blood pressure, etc., were generally not considered appropriate measures.

Two TRVs for each COPEC were selected from Attachment 5.2, one based on a NOAEL and the second based on a LOAEL.

Great Blue Heron, Kingfisher and Tree Swallow

There are no PCB toxicity data specifically for the great blue heron, kingfisher or tree swallow. There is a NOAEL for the white pelican (also a piscivore) of 27.2 mg/kgBW-day (70-day exposure), which may be relative to the great blue heron and kingfisher as piscivores. However, the endpoint is survival, and there are other studies that examine reproductive success (which is considered a more appropriate endpoint), although they are not for piscivores. There are a number of studies with chickens. In general, chicken studies were not used in the selection of TRVs, since chickens have been described as extremely sensitive to PCBs (Peakall 1986), and not representative of other receptors. There are data available for carnivorous birds which are believed to be the most relevant for the great blue heron, kingfisher and tree swallow: the American Kestrel and the screech owl. A LOAEL of 1.31 mg/kgBW-day Aroclor 1248 was reported for the American kestrel. Though the study duration was not reported, the endpoint was reproductive success. For Aroclor 1254, an effect (LOAEL) on spermagenesis occurred when kestrels were exposed over a period of 69 days at a dose of 14.4 mg/kgBW-day. "Low metabolic effects" were also reported in a kestrel study at 2.18 mg/kgBW-day Aroclor 1254, though the exposure period was relatively short, and the applicability of low metabolic effects to interpreting potential risk of PCBs is questionable. A TRV of 1.31 mg/kgBW-day was selected as the LOAEL.

NOAEL values are also reported for the American kestrel and the screech owl. No effect was observed on survival of kestrels over a 100-day study at a dose of 2.18 mg/kgBW-day Aroclor 1248. No effects were observed on reproduction in screech owl dosed at 0.86 mg/kgBW-day over two breeding seasons. A TRV of 0.86 mg/kgBW-day was selected as the NOAEL because reproduction is a more appropriate endpoint, and because the study duration looked at multiple breeding seasons.

Little Brown Bat

There are both LOAEL and NOAEL PCB data reported for bats in Attachment 5.2a. Effects on mortality and body weight (LOAEL) were observed at 139.1 mg/kgBW-day Aroclor 1260 in female brown bats (40-day exposure). No effects were observed in body weight at 2.09 mg/kgBW-day Aroclor 1260 over 40 days. In other studies, no effects were observed in litter weight and number of live litter of brown bats at 0.88 mg/kgBW-day Aroclor 1260 (28-day exposure), or on survival and growth in big brown bats at 0.885 mg/kgB-day (22-day exposure). There are no bat data for Aroclors 1254 or 1248. For Aroclor 1254, a 2-generation study in rats indicated reduced litter size at 1.5 mg/kgBW-day; and no effect was observed at 0.32 mg/kgBW-day. There are also data available for mink. However, mink are considered to be extremely sensitive to PCBs, and the Aroclor 1260 data for bats suggests that mink data are not representative for bats. Few toxicological data are available specific to Aroclor 1248. No effects have been reported in rats (clinical signs) at concentrations as low as 8 mg/kgBW-day; LOAELs for growth are reported at 91.5 mg/kgBW-day. Because data available for bats are limited to Aroclor 1260[8], and the studies are relatively short in duration, the Aroclor 1254 NOAEL and LOAEL values of 1.5 mg/kgBW-day and 0.32 mg/kgBW-day were selected as surrogate values to represent bats in the evaluation.

Mink

Mink are one of the most sensitive mammals to PCBs. From the ecotoxicological compilations in Attachment 5.2a, reproductive failure (LOAEL) was observed in 4 and 8-month studies of reproduction and kit survival at doses of 0.4 to 0.69 mg/kg-BW/day Aroclor 1254. Offspring mortality (LOAEL) was observed in a 6-month study at a dose of 0.15 mg/kg-BW/day Aroclor 1254. These studies are particularly relevant since the most prevalent Aroclor observed in fish tissue of Indian Creek and Blue River is Aroclor 1254, with lesser amounts of Aroclor 1248 and 1260[9]. Among NOAEL data, no effects in reproduction are reported at a dose of 0.14 mg/kg-BW/day Aroclor 1254. Based on these data, 0.15 mg/kg-BW/day was selected as a LOAEL TRV, and 0.14 mg/kg-BW/day was selected as a NOAEL TRV for mink.

V.D.2.3 Ecological Risk Characterization

[8] The primary Aroclor in sediments is Aroclor 1242.

[9] Though the source appears to consist primarily of Aroclor 1242, the effects of environmental "weathering" and "biofiltration (preferential uptake of certain PCB congeners) result in higher Aroclors being characterized in biological tissue.

This ERA is being conducted using the quotient method (Suter 1993a,b, 1995). An ecological effects quotient (EEQ) is calculated as the ratio between the predicted average daily dose (ADD) and the species-specific toxicity reference value (TRV). The following general guidelines were used to interpret EEQs:

- An EEQ_{NOAEL} less than 1suggests risks are low, and there is no need for further investigation.
- An EEQ_{NOAEL} greater than 1 and an EEQ_{LOAEL} less 1 suggests that there is a potential for risk. Whether the risk is "unacceptable", or if further information gathering and evaluation is warranted, will depend upon the uncertainty associated with the estimate, and the inherent conservatism built into the EEQ derivation process.
- An EEC_{LOAEL} greater than 1 suggests an elevated potential for risk. The conservatism built into the EEQ derivation process also plays a role in interpretation. Additional information collection and evaluation may be warranted, or steps may be taken to initiate evaluation of remedial alternatives.

A summary of results is presented in Table 5.61. The EEQ_{NOAEL} for each of the ROCs is less than 1. It is therefore concluded that risks are low for all ROCs, there is no need for further investigation, and that no remedial actions are necessary.

V.D.2.4 Ecological Uncertainty Analysis

Key conclusions from the problem formulation process and the results of evaluating assessment endpoints provide a line of evidence in support of the evaluation and results stated in the foregoing subsections. However, the nature and degree of uncertainties inherent in those findings must be considered. There are basically four sources of uncertainty in ecological risk assessment (EPA 1998; Suter 1993a):

- Stochasticity (natural variation)
- Lack of information (i.e., data gaps)
- Flawed model assumptions
- Human error

Natural variation (stochasticity) is an inherent characteristic of ecological systems and the factors that influence the systems (e.g., weather). Of all of the contributions to uncertainty, stochasticity is the only one that can be acknowledged and described but not reduced (Suter 1993a).

Generally speaking, the desktop approach as used in this evaluation, using limited site-specific data, particularly regarding the occurrence and behavior of potential receptors (e.g., mink), necessitates the application of consciously-biased assumptions. For example, the foraging areas (as reflected by home ranges, average flight distances, or other reported values) of individual wildlife receptors are highly variable and depend on the quality of the habitat. The more ideal the conditions of cover, structure, and (especially) forage, the smaller will be the area normally used by an animal. This evaluation generally uses the minimum reported home range in cases where a limited array of values is available, or the average where a robust set of observations is available. Other examples of information gaps that contribute to overestimation of exposures or effects include, but are not limited to those identified in the following table.

Source of Uncertainty	Impact
Bioavailability of COPECs	PCBs in sediments were assumed to be in a form that is 100% bioavailable. For example, no consideration was given to the effects of aging on bioavailability of sorbed PCBs, and subsequent exposures to invertebrates. However, concentrations of PCBs in benthic invertebrates were based on relationships with PCB concentrations in fish, and fish concentrations were directly measured. This approach considers bioavailability, since the concentrations in fish are reflective of bioavailability limitations. Therefore, the uncertainty associated with bioavailability in the context of PCB concentrations in the diet is not considered high in this evaluation.
Use of NOAELs	Use of NOAELs will generally overestimate the potential for effects since this measurement endpoint does not reflect any observed impacts. Use of both LOAELs and NOAELs provides a more balanced picture of the potential for adverse effects.
Temporal attenuation	Attenuating effects that would tend to reduce potential risks over time (e.g., degradation, dilution, reduced bioavailability) were not considered.
Extrapolation from literature-based TRVs (specifically laboratory bioassay results, where test chemicals are typically administered in forms and/or by methods intended to enhance uptake)	Generally, this is more likely to overestimate bioavailability under field conditions (although this may not always be true)
Multiple conservative assumptions	The cumulative impact of multiple conservative assumptions yields high predicted risks to ecological receptors.

TRVs are expressed as the NOAELs and LOAELs. The use, validity, and understanding of laboratory-based NOAELs and LOAELs lies in their experimental definitions. Experimentally, these values are determined statistically. The NOAEL is the dose at which no statistically significant adverse effects occur when compared to control values and the LOAEL is the lowest dose/concentration tested that results in statistically significant adverse effects when compared to a control. These parameters by definition are biased by the experimental design, specifically the statistical power of the test design. At low statistical power, it is possible that a 20% or 30% reduction in reproduction or growth could occur but be statistically defined as a NOAEL. Conversely, given a high level of statistical power, it is possible for a 1% or 5% reduction to be declared statistically less than a control and result in the test LOAEL. Statistical significance does not automatically relate to biological significance.

The EEQ is not intended to be "deterministic". However, it can be used to evaluate the potential level at which the measured or predicted exposure (EEC) relates to known levels at which adverse effects have or have not been demonstrated to occur (the LOAEL and NOAEL). The greater the departure from unity (where the EEC to TRV ratio [EEQ] is one), the greater the indication that either a potential risk is present (when the EEQ is much greater than 1) or there is little potential for risk (when the EEQ is much less than one). Values close to unity are the most uncertain where the assumptions used in estimating the EEC or the uncertainty associated with the use or derivation of the TRV become highly significant in the interpretation of the results. Nevertheless, these EEQs can be used in a "line-of-evidence" for the potential for ecological impact. Additionally, they are easily communicated to and understood by the public and other stakeholders. The issue of these values being defined as "deterministic" or as "criteria", however, has led to public confusion and misinterpretation that necessitates clearly defining their application and the uncertainty associated with their use in evaluating the potential for ecological impact. The EEQ tool as applied here should not be construed as an accurate "measure" of risk, but rather as an "indication" of risk.

There are two main information gaps that conceivably result in underestimation of potential adverse effects: inadequate analytical sensitivity, and lack of reliable toxicological information on amphibians and reptiles. For example, PCBs were not detected in water of Indian Creek or Blue River, and were not detected in sediments except within a short distance downstream from 002 Outfall. In the case of Indian Creek and Blue River, use of ½ the detection limit probably overestimates the exposure in surface water and sediments, because area uses of receptors are measured in kilometers, which would enable attenuation of PCBs with distance from the source. In other words, even if PCBs were present at ½ the detection limit near the source, the concentration would be far less moving further distant from 002 Outfall. This probably plays a minor role for this evaluation, since dietary PCB concentrations were either directly measured (in fish), or conservatively assumed (in benthos), and actual sediment and water ingestion of PCBs contributed little or none to the overall PCB dose for each of the receptors.

Another information gap relates to fish migration within Indian Creek and Blue River. However, there is reasonably large fish tissue concentration database over several kilometers of stream. These data indicate that PCBs (<1 mg/kg) are well below levels that would affect growth or reproduction (50 – 100 mg/kg [Niimi 1996]). Therefore, migration is not considered a significant factor in the evaluation of fish and potential impacts on fish reproduction in the Indian Creek system.

The inability to address amphibians and reptiles is probably the more important contribution to potential underestimation of adverse effects, at least with respect to ecological relevance. Certain frogs, lizards, and smaller snakes (all carnivores) are likely to be the most vulnerable of any wildlife to exposures, because they will derive virtually all of their diets from relatively confined areas. Whether these animals are more or less sensitive to the toxic effects of the PCBs is unknown.

There are also other data gaps that could result in either underestimation or overestimation of potential effects, including, but not limited to:

- Use of single-point estimates of exposure concentrations
- Use of TRVs from surrogate receptors applied to ROCs

With respect to the latter, the only ROC-specific TRV data that were available were for mink and bats. Surrogate data were used for each of the birds. This could result in underestimation or overestimation of potential risks.

An example of potentially flawed assumptions in this evaluation is the assumed dietary compositions of receptors. The diets are based on careful consideration of published information on populations considered most relevant to the site, but professional judgement necessarily played a role. To the extent that the assumed diets are inaccurate, they could result in either under or overestimation of exposures.

Human error is always possible, although most, if not all, simple mistakes of transcription and calculation are generally eliminated through meticulous technical review. Ecological risk assessment necessarily relies heavily on professional judgement (EPA 1992, 1998; Suter 1993a), which, to the extent that it may be erroneous, can also contribute to either under or overestimation of risk.

On balance, it is believed that most of the uncertainty associated with evaluating ecological risk for Indian Creek is associated with the degree to which exposures and toxicities are overestimated. There is a lesser possibility for false negative inferences (underestimation of risk) due to lack of certainty in the predicted dietary composition for some ROCs, as well as the use of TRVs derived from tests with surrogate organisms. However, the lines of evidence presented herein provide a reasonable level of confidence that risks are not underestimated, and that the evaluation effectively demonstrates that there are not significant ecological risks associated with PCBs sediments and surface water in Indian Creek.

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Tables

Human Health and Ecological Risk Assessments

TABLE 5.1
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF DEEP SOIL/SEDIMENT (EXCAVATION/CONSTRUCTION WORKER)

$$\textit{Intake Factor} = \frac{IR \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (mg/day)[1]	50	100
ME:	Matrix effect (unitless)[2]	0.5	1
EF:	Exposure frequency (days/year)[3]	15	30
ED:	Exposure duration (years)[4]	1	1
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[5]	71.8	71.8
AT:	Averaging time (days)[6]		
	Noncarcinogenic	21	42
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	2.49E-07	9.95E-07
	Carcinogenic	1.91E-10	1.53E-09

[1] IR: 50 mg/kg is the value recommended in EPA (1997a) as a reasonable central estimate of adult soil ingestion. The The RME rate is the upper end of the adult range of 1 to 100 mg/kg reported by Calabrese (1987).

[2] ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.

[3] EF: Estimated duration of excavation/construction activities; 5 days/week for 3 weeks in the central tendency case and 5 days/week for 6 weeks in the RME case.

[4] ED: Excavation/construction activities are assumed to be completed within one year.

[5] BW: The recommended average adult body weight (EPA 1997a)

[6] AT: ED x 21 days/year (3 full weeks) in the central tendency evaluation, or 42 days/year (6 full weeks) in the RME case for noncarcinogens; 75 years x 365 days/year for carcinogens. Carcinogenic averaging time from EPA (1997a).

TABLE 5.2
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH DEEP SOIL/SEDIMENT (EXCAVATION/CONSTRUCTION WORKER)

$$\textit{Intake Factor} = \frac{SA \times AB \times AF \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
SA:	Surface Area (cm^2/day)[1]	3,160	5,230
AB:	Absorbed Fraction[2]	0.07	0.14
AF:	Adherence Factor (mg/cm^2)[3]	0.2	1
EF:	Exposure frequency (days/year)[4]	15	30
ED:	Exposure duration (years)[5]	1	1
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[6]	71.8	71.8
AT:	Averaging time (days)[7]		
	Noncarcinogenic	21	42
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	4.40E-07	7.28E-06
	Carcinogenic	3.38E-10	1.12E-08

[1] SA: The worker is assumed to wear clothing appropriate for weather and type of outdoor work. Central tendency surface area (3,160 cm^2) is equivalent to head, forearms and hands (assumes the worker is wearing a short-sleeve shirt, jeans, and boots); RME surface area (5,230 cm^2) is equivalent to head, forearms, hands, and lower legs (assumes the worker is wearing a short-sleeve shirt, shorts, and boots) (EPA 1997a).

[2] AB: RME value is recommended by EPA (EPA 2000b). See Section V.C.1.3.1. The central tendency value is one-half the RME value.

[3] AF: EPA recommended dermal soil adherence factors for dermal exposure to soil (EPA 1992a). RME value is the upper end of the recommended range. The central tendency value is the lower end of the range. See Section V.C.1.3 1.

[4] EF: Estimated duration of excavation activities; 5 days/week for 3 weeks in the average case and 5 days/week for 6 weeks in the RME case.

[5] ED: Excavation/construction activities are assumed to be completed within one year.

[6] BW: The recommended average adult body weight (EPA 1997a)

[7] AT: ED x 21 days/year (3 full weeks) in the central tendency evaluation, or 42 days/year (6 full weeks) in the RME case for noncarcinogens; 75 years x 365 days/year for carcinogens. Carcinogenic averaging time from EPA (1997a).

TABLE 5.3
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF SHALLOW SOIL (UTILITY WORKER)

$$Intake\ Factor = \frac{IR \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (mg/day)[1]	50	100
ME:	Matrix effect (unitless)[2]	0.5	1
EF:	Exposure frequency (days/year)[3]	15	30
ED:	Exposure duration (years)[4]	1	1
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[5]	71.8	71.8
AT:	Averaging time (days)[6]		
	Noncarcinogenic	21	42
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	2.49E-07	9.95E-07
	Carcinogenic	1.91E-10	1.53E-09

[1] IR: 50 mg/kg is the value recommended in EPA (1997a) as a reasonable central estimate of adult soil ingestion. The The RME rate is the upper end of the adult range of 1 to 100 mg/kg reported by Calabrese (1987).

[2] ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.

[3] EF: Estimated duration of excavation/construction activities; 5 days/week for 3 weeks in the central tendency case and 5 days/week for 6 weeks in the RME case.

[4] ED: Excavation/construction activities are assumed to be completed within one year.

[5] BW: The recommended average adult body weight (EPA 1997a)

[6] AT: ED x 21 days/year (3 full weeks) in the central tendency evaluation, or 42 days/year (6 full weeks) in the RME case for noncarcinogens; 75 years x 365 days/year for carcinogens. Carcinogenic averaging time from EPA (1997a).

TABLE 5.4
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH SHALLOW SOIL (UTILITY WORKER)

$$\text{Intake Factor} = \frac{SA \times AB \times AF \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
SA:	Surface Area (cm^2/day)[1]	3.160	5.230
AB:	Absorbed Fraction[2]	0.07	0.14
AF:	Adherence Factor (mg/cm^2)[3]	0.2	1
EF:	Exposure frequency (days/year)[4]	15	30
ED:	Exposure duration (years)[5]	1	1
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[6]	71.8	71.8
AT:	Averaging time (days)[7]		
	Noncarcinogenic	21	42
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	4.40E-07	7.28E-06
	Carcinogenic	3.38E-10	1.12E-08

[1] SA: The worker is assumed to wear clothing appropriate for weather and type of outdoor work. Central tendency surface area (3,160 cm^2) is equivalent to head, forearms and hands (assumes the worker is wearing a short-sleeve shirt, jeans, and boots); RME surface area (5,230 cm^2) is equivalent to head, forearms, hands, and lower legs (assumes the worker is wearing a short-sleeve shirt, shorts, and boots) (EPA 1997a).

[2] AB: RME value is recommended by EPA (EPA 2000b). See Section V.C.1.3.1. The central tendency value is one-half the RME value.

[3] AF: EPA recommended dermal soil adherence factors for dermal exposure to soil (EPA 1992a). RME value is the upper end of the recommended range. The central tendency value is the lower end of the range. See Section V.C.1.3.1.

[4] EF: Estimated duration of excavation activities; 5 days/week for 3 weeks in the average case and 5 days/week for 6 weeks in the RME case.

[5] ED: Excavation/construction activities are assumed to be completed within one year.

[6] BW: The recommended average adult body weight (EPA 1997a)

[7] AT: ED x 21 days/year (3 full weeks) in the central tendency evaluation, or 42 days/year (6 full weeks) in the RME case for noncarcinogens; 75 years x 365 days/year for carcinogens. Carcinogenic averaging time from EPA (1997a).

TABLE 5.5
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF SURFACE WATER (CONSTRUCTION WORKER)

$$Intake\ Factor = \frac{IR \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (ml/day)[1]	5	10
EF:	Exposure frequency (days/year)[2]	15	30
ED:	Exposure duration (years)[3]	1	1
CF:	Conversion factor (L/ml)	1E-03	1E-03
BW:	Body weight (kg)[4]	71.8	71.8
AT:	Averaging time (days)[5]		
	Noncarcinogenic	21	42
	Carcinogenic	27,375	27,375
Intake Factor (L/kg-day)			
	Noncarcinogenic	4.97E-05	9.95E-05
	Carcinogenic	3.82E-08	1.53E-07

[1] IR: Estimated rates of incidental water ingestion is based on water ingestion rates for a swimmer. See Section V.C.1.3.1.

[2] EF: Estimated duration of construction activities; 5 days/week for 3 weeks in the central tendency case and 5 days/week for 6 weeks in the RME case.

[3] ED: Construction activities are assumed to be completed within one year.

[4] BW: The recommended average adult body weight (EPA 1997a)

[5] AT: ED x 21 days/year (3 full weeks) in the central tendency evaluation, or 42 days/year (6 full weeks) in the RME case for noncarcinogens; 75 years x 365 days/year for carcinogens. Carcinogenic averaging time from EPA (1997a).

TABLE 5.6
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH SURFACE WATER (CONSTRUCTION WORKER)

$$\text{Intake Factor} = \frac{SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Parameter	Central Tendency	Reasonable Maximum
SA: Surface Area (cm^2)[1]	3,160	5,230
PC: Permeability Coefficient (cm/hr)[2]	0.77	0.77
ET: Exposure Time (hours/day)[3]	4	4
EF: Exposure frequency (days/year)[4]	15	30
ED: Exposure duration (years)[5]	1	1
CF: Conversion factor (L/cm^3)	1E-03	1E-03
BW: Body weight (kg)[6]	71.8	71.8
AT: Averaging time (days)[7]		
Noncarcinogenic	21	42
Carcinogenic	27,375	27,375
Intake Factor (L/kg-day)		
Noncarcinogenic	9.68E-02	1.60E-01
Carcinogenic	7.43E-05	2.46E-04

[1] SA: The worker is assumed to wear clothing appropriate for weather and type of outdoor work. Central tendency surface area (3,160 cm^2) is equivalent to head, forearms and hands (assumes the worker is wearing a short-sleeve shirt, jeans, and boots); RME surface area (5,230 cm^2) is equivalent to head, forearms, hands, and lower legs (assumes the worker is wearing a short-sleeve shirt, shorts, and boots) (EPA 1997a).

[2] PC: Permeability constants are chemical-specific values used to define uptake of chemicals for aqueous media. Value is used in this risk assessment is from EPA (1998). See Section V.C.1.3.1.

[3] ET: The central tendency and RME value represents one-half the standard workday. This value was used because it is unlikely that a worker would have wet clothing for the entire 8 hour workday.

[4] EF: Estimated duration of construction activities: 5 days/week for 3 weeks in the central tendency case and 5 days/week for 6 weeks in the RME case.

[5] ED: Construction activities are assumed to be completed within one year.

[6] BW: The recommended average adult body weight (EPA 1997a).

[7] AT: ED x 21 days/year (3 full weeks) in the central tendency evaluation, or 42 days/year (6 full weeks) in the RME case for noncarcinogens; 75 years x 365 days/year for carcinogens. Carcinogenic averaging time from EPA (1997a).

TABLE 5.7
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF SEDIMENT (RECREATIONAL RECEPTOR - ADULT)

$$\textit{Intake Factor} = \frac{IR \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (mg/day)[1]	50	100
ME:	Matrix effect (unitless)[2]	0.5	1
EF:	Exposure frequency (days/year)[3]	26	52
ED:	Exposure duration (years)[4]	9	30
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[5]	71.8	71.8
AT:	Averaging time (days)[6]		
	Noncarcinogenic	3.285	10.950
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	2.48E-08	1.98E-07
	Carcinogenic	2.98E-09	7.94E-08

[1] IR: 50 mg/kg is the value recommended in EPA (1997a) as a reasonable central estimate of adult soil ingestion. The RME value is the upper end of the adult range of 1 to 100 mg/kg reported by Calabrese (1987).

[2] ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.

[3] EF: Central tendency value assumes one visit per week to site for 26 weeks. RME value assumes two visits per week for 26 weeks.

[4] ED: Central tendency and RME values are the 50th and 90th percentile duration of residence in a single location (EPA 1997a).

[5] BW: The recommended average adult body weight (EPA 1997a).

[6] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.8
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH SEDIMENT
(RECREATIONAL RECEPTOR - ADULT)

$$\text{Intake Factor} = \frac{SA \times AB \times AF \times EF \times ED \times CF}{BW \times AT}$$

Parameter	Central Tendency	Reasonable Maximum
SA: Surface Area (cm^2/day)[1]	4,050	7,780
AB: Absorbed Fraction[2]	0.07	0.14
AF: Adherence Factor (mg/cm^2)[3]	0.2	1
EF: Exposure frequency (days/year)[4]	26	52
ED: Exposure duration (years)[5]	9	30
CF: Conversion factor (kg/mg)	1E-06	1E-06
BW: Body weight (kg)[6]	71.8	71.8
AT: Averaging time (days)[7]		
Noncarcinogenic	3,285	10,950
Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)		
Noncarcinogenic	5.63E-08	2.16E-06
Carcinogenic	6.75E-09	8.64E-07

[1] SA: Central tendency value of 4,050 is equivalent to forearms, hands, and lower legs; the RME value of 7,780 is equivalent to head, entire arm, hands, lower legs, and feet (EPA 1997a).

[2] AB: RME value is recommended by EPA (EPA 2000b). See Section V.C.1.3.1. The central tendency value is one-half the RME value.

[3] AF: EPA recommended dermal soil adherence factors for dermal exposure to soil (USEPA 1992a). RME value is the upper end of the recommended range. The central tendency value is the lower end of the range. See Section V.C.1.3.1.

[4] EF: Central tendency value assumes one visit per week to site for 26 weeks. RME value assumes two visits per week for 26 weeks.

[5] ED: Central tendency and RME values are the 50th and 90th percentile duration of residence in a single location (EPA 1997a).

[6] BW: The recommended average adult body weight is 71.8 kg (EPA 1997a).

[4] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.9
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF SURFACE WATER (RECREATIONAL RECEPTOR - ADULT)

$$\textit{Intake Factor} = \frac{IR \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (ml/day)[1]	5	10
EF:	Exposure frequency (days/year)[2]	26	52
ED:	Exposure duration (years)[3]	9	30
CF:	Conversion factor (L/ml)	1E-03	1E-03
BW:	Body weight (kg)[4]	71.8	71.8
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3,285	10,950
	Carcinogenic	27,375	27,375
Intake Factor (L/kg-day)			
	Noncarcinogenic	4.96E-06	1.98E-05
	Carcinogenic	5.95E-07	7.94E-06

[1] IR: Estimated rates of inccidental water ingested. 10 ml/day is one-fifth the incidental water ingestion rate while swimming (50 ml/swimming event, 1.0 hr/event, 1 event/day) reported in EPA 1988. The central tendency value is one-half the RME value.

[2] EF: Central tendency value assumes one visit per week to site for 26 weeks. RME value assumes two visits per week for 26 weeks.

[3] ED: Central tendency and RME values are the 50th and 90th percentile duration of residence in a single location (EPA 1997a).

[4] BW The recommended average adult body weight (EPA 1997a).

[5] AT ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.10
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH SURFACE WATER (RECREATIONAL RECEPTOR - ADULT)

$$\textit{Intake Factor} = \frac{SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Parameter	Central Tendency	Reasonable Maximum
SA: Surface Area (cm^2)[1]	4.050	7.780
PC: Permeability Coefficient (cm/hr)[2]	0.77	0.77
ET: Exposure Time (hours/day)[3]	2	4
EF: Exposure frequency (days/year)[4]	26	52
ED: Exposure duration (years)[5]	9	30
CF: Conversion factor (L/cm^3)	1E-03	1E-03
BW: Body weight (kg)[6]	71.8	71.8
AT: Averaging time (days)[7]		
Noncarcinogenic	3.285	10.950
Carcinogenic	27.375	27.375
Intake Factor (L/kg-day)		
Noncarcinogenic	6.19E-03	4.75E-02
Carcinogenic	7.43E-04	1.90E-02

[1] SA: Central tendency value of 4.050 is equivalent to forearms, hands, and lower legs. RME value of 7.780 is equivalent to head, entire arm, hands, lower legs, and feet (EPA 1997a). Receptors are assumed to have exposure to surface water in the creek only while fishing.

[2] PC: Permeability constants are chemical-specific values used to define uptake of chemicals for aqueous media. The value used in this risk assessment is from EPA (1998). See Section V.C.1.3.1.

[3] ET: Recreational receptors are assumed to spend 2 hours (after work) and 4 hours (weekends) at the site in the central tendency and RME cases, respectively.

[4] EF: Central tendency value of 26 days/year assumes one visit per week to the site for 26 weeks. RME value of 52 days/year assumes two visits per week for 26 weeks.

[5] ED: Central tendency and RME values are the 50th and 90th percentile duration of residence in a single location (EPA 1997a).

[6] BW: The recommended average adult body weight (EPA 1997a).

[7] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.11
INGESTION OF FISH INTAKE ASSUMPTIONS
(RECREATIONAL RECEPTOR - ADULT)

$$\textit{Intake Factor} = \frac{IR \times FC \times EF \times ED \times CF}{BW \times AT}$$

Parameter	Central Tendency	Reasonable Maximum
IR: Ingestion Rate per species (g/day)[1]	8	22.6
FC: Fraction ingested from contaminated source[2]	0.1	0.25
EF: Exposure frequency (days/year)[3]	365	365
ED: Exposure duration (years)[4]	9	30
CF: Conversion factor (kg/g)	1E-03	1E-03
BW: Body weight (kg)[5]	71.8	71.8
AT: Averaging time (days)[6]		
Noncarcinogenic	3,285	10,950
Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)		
Noncarcinogenic	1.11E-05	7.87E-05
Carcinogenic	1.34E-06	3.15E-05

[1] IR: The central tendency and RME values are one-half the mean (16 g) and 95th percentile (45.2 g) estimates of total fish consumption by African-Americans (EPA 1997a, Table 10-1). One-half the recommended values is used to calcuate the intake factor because recreational receptors were assumed to ingest both channel catfish and green sunfish. Therefore, the potential risks would be estimated on a total of 16 g and 45.2 g in the central tendency and RME case, respectively. See Section V.C.1.3.1.

[2] FC: The central tendency value assumes that 10% of the fish consumed have been impacted by the site; the RME value assumes that 25% of the fish consumed have been impacted by the site.

[3] EF Exposure frequency is assumed to be 365 days/year. This value is used because the intake rate is based on the number of grams of fish ingested on a daily basis in a year's time.

[4] ED: 50th and 90th percentile duration of residence in a single location (EPA 1997a).

[5] BW The average adult body weight is 71.8 kg (EPA 1997a).

[6] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.12
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF SEDIMENT (RECREATIONAL RECEPTOR - CHILD)

$$\text{Intake Factor} = \frac{IR \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (mg/day)[1]	100	200
ME:	Matrix effect (unitless)[2]	0.5	1
EF:	Exposure frequency (days/year)[3]	26	52
ED:	Exposure duration (years)[4]	9	9
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[5]	45.3	45.3
AT:	Averaging time (days)[6]		
	Noncarcinogenic	3,285	3,285
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	7.86E-08	6.29E-07
	Carcinogenic	9.43E-09	7.55E-08

[1] IR: The central tendency and RME ingestion rates are the Standard Default Exposure Factors recommended by EPA (1991a).

[2] ME: Compounds adhered to soil are commonly less available for absorption than the same compound ingested in solution in laboratory experiments. The soil matrix has the effect of reducing the available dose of the compound. Matrix effect is expressed as a fraction between 0 and 1. A matrix effect of 1 represents 100 percent available for absorption.

[3] EF: The central tendency exposure frequency is estimated to be 26 days/year (1 day/week for 26 weeks) and assumes that outdoor activities are modified by the weather. The RME exposure frequency is estimated to be 52 days (2 days/week for 26 weeks).

[4] ED: Central tendency and RME exposure durations represent children visiting the site from ages 6-15.

[5] BW: The value is the mean body weight for boys and girls 12 years old (EPA 1997a. Table 7-3).

[6] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.13
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH SEDIMENT (RECREATIONAL RECEPTOR - CHILD)

$$\text{Intake Factor} = \frac{SA \times AB \times AF \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
SA:	Surface Area (cm^2/day)[1]	4,050	7,780
AB:	Absorbed Fraction[2]	0.07	0.14
AF:	Adherence Factor (mg/cm^2)[3]	0.2	1
EF:	Exposure frequency (days/year)[4]	26	52
ED:	Exposure duration (years)[5]	9	9
CF:	Conversion factor (kg/mg)	1E-06	1E-06
BW:	Body weight (kg)[6]	45.3	45.3
AT:	Averaging time (days)[7]		
	Noncarcinogenic	3,285	3,285
	Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)			
	Noncarcinogenic	8.92E-08	3.43E-06
	Carcinogenic	1.07E-08	4.11E-07

[1] SA: Central tendency surface area is equivalent to hands, forearms, and lower legs (EPA 1997a). RME surface area is equivalent to head, hands, arms, lower legs, and feet (EPA 1997a). Note: EPA (1997a) indicates uncertainty with surface area estimations for children older than 13. Therefore, the adult recreational receptor surface area is used for the child recreational receptor.

[2] AB: RME value is recommended by EPA (EPA 2000b). See Section V.C.1.3.1.
The central tendency value is one-half the RME value.

[3] AF: USEPA recommended dermal soil adherence factors for dermal exposure to soil (EPA 1992a). RME value is the upper end of the recommended range. The central tendency value is the lower end of the range. See Section V.C.1.3.1.

[4] EF: The central tendency exposure frequency is estimated to be 26 days/year (1 day/week for 26 weeks) and assumes that outdoor activities are modified by the weather. The RME exposure frequency is estimated to be 52 days/year (2 days/week for 26 weeks).

[5] ED: Central tendency and RME exposure durations represent children visiting the site from ages 6-15.

[6] BW: The value is the mean body weight for boys and girls 12 years old (EPA 1997a. Table 7-3).

[7] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.14
INTAKE ASSUMPTIONS FOR INCIDENTAL INGESTION OF SURFACE WATER (RECREATIONAL RECEPTOR - CHILD)

$$\text{Intake Factor} = \frac{IR \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
IR:	Ingestion Rate (ml/day)[1]	5	10
EF:	Exposure frequency (days/year)[2]	26	52
ED:	Exposure duration (years)[3]	9	9
CF:	Conversion factor (L/ml)	1E-03	1E-03
BW:	Body weight (kg)[4]	45.3	45.3
AT:	Averaging time (days)[5]		
	Noncarcinogenic	3.285	3.285
	Carcinogenic	27,375	27.375
Intake Factor (L/kg-day)			
	Noncarcinogenic	7.86E-06	3.14E-05
	Carcinogenic	9.43E-07	3.77E-06

[1] IR: Estimated rates of incidental water ingested. 10 ml/day is one-fifth the incidental water ingestion rate while swimming (50 ml/swimming event, 1.0 hr/event, 1 event/day) reported in EPA 1988. The central tendency value is one-half the RME value.

[2] EF: The central tendency exposure frequency is estimated to be 26 days/year (1 day/week for 26 weeks) and assumes that outdoor activities are modified by the weather. The RME exposure frequency is estimated to be 52 days/year (2 days/week for 26 weeks).

[3] ED: Central tendency and RME exposure durations represent children visiting the site from ages 6-15.

[4] BW: The value is the mean body weight for boys and girls 12 years old (EPA 1997a, Table 7-3).

[5] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.15
INTAKE ASSUMPTIONS FOR DERMAL CONTACT WITH SURFACE WATER (RECREATIONAL RECEPTOR - CHILD)

$$Intake\ Factor = \frac{SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	Central Tendency	Reasonable Maximum
SA:	Surface Area (cm^2)[1]	4,050	7,780
PC:	Permeability Coefficient (cm/hr)[2]	0.77	0.77
ET:	Exposure Time (hours/day)[3]	2	4
EF:	Exposure frequency (days/year)[4]	26	52
ED:	Exposure duration (years)[5]	9	9
CF:	Conversion factor (L/cm^3)	1E-03	1E-03
BW:	Body weight (kg)[6]	45.3	45.3
AT:	Averaging time (days)[7]		
	Noncarcinogenic	3,285	3,285
	Carcinogenic	27,375	27,375
Intake Factor (L/kg-day)			
	Noncarcinogenic	9.81E-03	7.54E-02
	Carcinogenic	1.18E-03	9.04E-03

[1] SA: Central tendency value of 5,230 is equivalent to forearms, hands, and lower legs. RME value of 7,780 is equivalent to head, entire arm, hands, lower legs, and feet (EPA 1997a). Receptors were assumed to have exposure to surface water while wading or fishing.

[2] PC: Permeability constants are chemical-specific values used to define uptake of chemicals for aqueous media. The value used in this risk assessment is from EPA (1998). See Section V.C.1.3.1.

[3] ET: The central tendency exposure time represents time spent after school; reasonable maximum exposure time represents time spent on site during the weekend.

[4] EF: The central tendency exposure frequency is estimated to be 26 days/year (1 day/week for 26 weeks) and assumes that outdoor activities are modified by the weather. The RME exposure frequency is estimated to be 52 days/year (2 days/weeks for 26 weeks).

[5] ED: Central tendency and RME exposure durations represent children visiting the site from ages 6-15.

[6] BW: The value is the mean body weight for boys and girls 12 years old (EPA 1997a, Table 7-3).

[7] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.16
INGESTION OF FISH INTAKE ASSUMPTIONS
(RECREATIONAL RECEPTOR - CHILD)

$$\text{Intake Factor} = \frac{IR \times FC \times EF \times ED \times CF}{BW \times AT}$$

Parameter	Central Tendency	Reasonable Maximum
IR: Ingestion Rate per species (g/day)[1]	4	11.5
FC: Fraction ingested from contaminated source[2]	0.1	0.25
EF: Exposure frequency (days/year)[3]	365	365
ED: Exposure duration (years)[4]	9	9
CF: Conversion factor (kg/g)	1E-03	1E-03
BW: Body weight (kg)[5]	45.3	45.3
AT: Average time (days)[6]		
Noncarcinogenic	3,285	3,285
Carcinogenic	27,375	27,375
Intake Factor (kg/kg-day)		
Noncarcinogenic	8.83E-06	6.35E-05
Carcinogenic	1.06E-06	7.62E-06

[1] IR: The central tendency and RME values are based on one-half the adult ingestion values (see Table 5.1-9). As with the adult values, one-half the total grams of fish ingested was used to calculate the intake factor to allow for the ingestion of both channel catfish and green sunfish. Total grams ingested for the child receptor were considered to be 8 grams and 23 grams in the average and RME case, respectively.

[2] FC: The central tendency value assumes that 10% of the fish consumed have been impacted by the site; the RME value assumes that 25% of the fish consumed have been impacted by the site.

[3] EF Exposure frequency is assumed to be 365 days/year. This value is used because the intake rate is based on the number of grams of fish ingested on a daily basis in a year's time.

[4] ED: Central tendency and RME exposure durations represent children visiting the site from ages 6-15.

[5] BW: The value is the mean body weight for boys and girls 12 years old (EPA 1997a. Table 7-3).

[6] AT: ED x 365 days/year for noncarcinogens; 75 years x 365 days/year for carcinogens (EPA 1997a).

TABLE 5.17
SUMMARY OF PCB EXPOSURE POINT CONCENTRATIONS IN MEDIA OF CONCERN

Media	Receptor Population	Total PCBs	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Deep Soil (mg/kg)	Excavation Worker	13	0.52	0.039		0.074
Shallow Soil (mg/kg)	Utility Worker	2.12	1.07	0.87		0.063
Sediment (mg/kg)	Construction Worker	354	371	2.98		3.25
Sediment (mg/kg)	Recreational	2.38	2.3	0.4		
Surface Water (mg/L)	Construction Worker	0.000898	0.00088	0.000058		0.000054
Surface Water (mg/L)	Recreational	0.000653	0.0006	0.000059		0.000051
Channel Catfish (mg/kg)	Recreational	1.01		0.28	0.958	0.088
Green Sunfish (mg/kg)	Recreational	0.178		0.032	0.072	0.022

PCB concentrations are from Table 5.18 through 5.27.

TABLE 5.18
CONCENTRATIONS OF PCBs IN DEEP SOILS - EXCAVATION WORKER EXPOSURES

	Aroclor - 1242 (ug/kg)				Aroclor - 1248 (ug/kg)				Aroclor - 1260 (ug/kg)		
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	RL	Qual
BHAIC95T9607-01-10	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-15	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-20	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-25	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-30	**110**	4.7005	33		16.5	2.8034	33	U			
BHAIC95T9607-01-35	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-40	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-45	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-01-50	16	2.7726	32	U	16	2.7726	32	U			
BHAIC95T9607-01-53	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-11	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-16	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-21	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-31	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-36	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-41	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-46	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-51	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-02-54	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-03-11	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-03-16	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-03-21	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-03-26	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-03-31	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9607-03-36	**1500**	7.3132	160		80	4.3820	160	U			
BHAIC95T9607-03-41	**270**	5.5984	33		16.5	2.8034	33	U			
BHAIC95T9607-03-46	**140**	4.9416	33		16.5	2.8034	33	U			
BHAIC95T9607-03-49	**6900000**	15.7470	330		165	5.1059	330	U			
BHAIC95T9610-01-10	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-15	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-20	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-25	165	5.1059	330	U	165	5.1059	330	U			
BHAIC95T9610-01-30	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-35	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-40	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-45	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-01-48	16.5	2.8034	33	U	16.5	2.8034	33	U			

TABLE 5.18
CONCENTRATIONS OF PCBs IN DEEP SOILS - EXCAVATION WORKER EXPOSURES

	Aroclor - 1242 (ug/kg)				Aroclor - 1248 (ug/kg)				Aroclor - 1260 (ug/kg)		
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	RL	Qual
BHAIC95T9610-02-10	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-15	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-20	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-25	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-30	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-35	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-40	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-45	16.5	2.8034	33	U	16.5	2.8034	33	U			
BHAIC95T9610-02-47	16	2.7726	32	U	16	2.7726	32	U			
BHAIC95T9807-06-12	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	33	U
BHAIC95T9807-06-15	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	33	U
BHAIC95T9807-06-19	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	33	U
BHAIC95T9807-06-22	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	33	U
BHAIC95T9807-06-27	**40**	3.6889	33		16.5	2.8034	33	U	16.5	33	U
BHAIC95T9807-06-32	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	33	U
BHAIC95T9807-06-37	**630**	6.4457	33		16.5	2.8034	33	U	**74**	33	
BHAIC95T9807-06-41	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	33	U
BHAIC95T9808-01-12	**56**	4.0254	33		16.5	2.8034	33	U			
KC98-233-980804-10	80	4.3820	160	U	**2500**	7.8240	160				
KC98-233-980804-15	**550**	6.3099	160		80	4.3820	160	U			
KC98-233-980804-20	80	4.3820	160	U	80	4.3820	160	U			
KC98-233-980804-25	80	4.3820	160	U	80	4.3820	160	U			
Number	59				59				8		
Minimum Detection	40				2500				74		
Maximum Detection	6900000				2500				74		
Average	117025	3.49			68	3.07			24		
Standard Deviation	898294	1.93			324	0.85			20		
H Statistic		3.533				2.158					
95% UCL		520				39					
RME		520				39			74		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
BOLD = Analyte detected in sample

TABLE 5.18
CONCENTRATIONS OF PCBs IN DEEP SOILS - EXCAVATION WORKER EXPOSURES

	Aroclor - 1242 (ug/kg)				Aroclor - 1248 (ug/kg)				Aroclor - 1260 (ug/kg)		
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	RL	Qual

Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.
Note: Data sets with fewer than 10 samples are too small to calculate a 95% UCL.
Therefore, the maximum detected concentration was used as the RME.

TABLE 5.19
CONCENTRATIONS OF TOTAL PCBs IN DEEP SOIL - EXCAVATION WORKER EXPOSURE

	Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual
AI15-15	0.08	-2.5257	0.16	U
AI15-18	0.08	-2.5257	0.16	U
AI16-15	0.08	-2.5257	0.16	U
AI16-21	0.08	-2.5257	0.16	U
AI16-24	0.08	-2.5257	0.16	U
AI16-27	0.08	-2.5257	0.16	U
AI16-30	0.08	-2.5257	0.16	U
AI16-33	0.08	-2.5257	0.16	U
AI16-36	0.08	-2.5257	0.16	U
AI16-39	0.08	-2.5257	0.16	U
AI17-24	0.08	-2.5257	0.16	U
AI17-27	**0.25**	-1.3863	0.16	
AI17-30	**0.75**	-0.2877	0.16	
AI17-33	0.08	-2.5257	0.16	U
AI17-36	0.08	-2.5257	0.16	U
AI17-39	0.08	-2.5257	0.16	U
AI17-42	0.08	-2.5257	0.16	U
AI18-15	0.08	-2.5257	0.16	U
AI18-21	0.08	-2.5257	0.16	U
AI18-24	0.08	-2.5257	0.16	U
AI18-30	0.08	-2.5257	0.16	U
AI18-33	0.08	-2.5257	0.16	U
AI18-36	0.08	-2.5257	0.16	U
AI18-39	0.08	-2.5257	0.16	U
AI18-42	0.08	-2.5257	0.16	U
AI19-15	0.08	-2.5257	0.16	U
AI19-21	0.08	-2.5257	0.16	U
AI19-24	**0.09**	-2.4079	0.16	
AI19-27	0.08	-2.5257	0.16	U
AI19-30	0.08	-2.5257	0.16	U
AI19-33	0.08	-2.5257	0.16	U
AI19-36	0.08	-2.5257	0.16	U
AI19-39	0.08	-2.5257	0.16	U
AI45-10	0.5	-0.6931	1.0	U
AI45-15	**160**	5.0752	1.0	
AI45-20	**1300**	7.1701	1.0	
AI45-22	**1800**	7.4955	1.0	
AI46-10	**31**	3.4340	1.0	
AI46-15	**2.7**	0.9933	1.0	
AI46-20	**200**	5.2983	1.0	
AI47-12	**7.8**	2.0541	1.0	
AI47-12	0.5	-0.6931	1.0	U
AI47-16	**1**	0.0000	1.0	
AI47-21	**1.9**	0.6419	1.0	
AI48-10	0.5	-0.6931	1.0	U
AI48-10	0.5	-0.6931	1.0	U
AI48-15	0.5	-0.6931	1.0	U
AI48-21	**1.2**	0.1823	1.0	
AI49-10	0.5	-0.6931	1.0	U
AI49-15	0.5	-0.6931	1.0	U
AI49-20	0.5	-0.6931	1.0	U
AI50-12	0.5	-0.6931	1.0	U
AI50-20	**1.2**	0.1823	1.0	
AI51-11	**1.1**	0.0953	1.0	
AI51-16	**2.2**	0.7885	1.0	
AI51-20	**1700**	7.4384	1.0	
AI52-16	**1.4**	0.3365	1.0	

TABLE 5.19
CONCENTRATIONS OF TOTAL PCBs IN DEEP SOIL - EXCAVATION WORKER EXPOSURE

	Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual
AI52-20	**29**	3.3673	1.0	
AI53-10	**13**	2.5649	1.0	
AI53-15	0.5	-0.6931	1.0	U
AI53-20	**5**	1.6094	1.0	
AI54-10	**1.1**	0.0953	1.0	
AI54-20	**8**	2.0794	1.0	
AI55-10	**2**	0.6931	1.0	
AI55-15	**18**	2.8904	1.0	
AI55-20	**750**	6.6201	1.0	
AI56-18	0.5	-0.6931	1.0	U
AI56-23	0.5	-0.6931	1.0	U
AI56-30	0.5	-0.6931	1.0	U
AI56-35	0.5	-0.6931	1.0	U
AI56-40	**13**	2.5649	1.0	
AI56-45	**2**	0.8329	1.0	
AI56-47.5	**78**	4.3567	1.0	
AI57-24	0.5	-0.6931	1.0	U
AI57-29	0.5	-0.6931	1.0	U
AI57-33	0.5	-0.6931	1.0	U
AI57-39	0.5	-0.6931	1.0	U
AI57-44	**1300**	7.1701	1.0	
AI57-48	**1.4**	0.3365	1.0	
AI57-51.5	**1.8**	0.5878	1.0	
AI58-19	0.5	-0.6931	1.0	U
AI58-23	0.5	-0.6931	1.0	U
AI58-28	0.5	-0.6931	1.0	U
AI58-44	**360**	5.8861	1.0	
AI58-49.5	**2.4**	0.8755	1.0	
AI58-9	0.5	-0.6931	1.0	U
AI59-20	0.5	-0.6931	1.0	U
AI59-30	**2.2**	0.7885	1.0	
AI59-35	**4.6**	1.5261	1.0	
AI59-40	**260**	5.5607	1.0	
AI59-45.5	**8300**	9.0240	1.0	
AI60-18	**3.1**	1.1314	1.0	
AI60-25	**1.2**	0.1823	1.0	
AI60-30	0.5	-0.6931	1.0	U
AI60-35	**1.5**	0.4055	1.0	
AI60-45	**78**	4.3567	1.0	
AI61-12	0.5	-0.6931	1.0	U
AI61-23	0.5	-0.6931	1.0	U
AI61-27	0.5	-0.6931	1.0	U
AI61-33	0.5	-0.6931	1.0	U
AI61-37	0.5	-0.6931	1.0	U
AI61-42	0.5	-0.6931	1.0	U
AI61-45	0.5	-0.6931	1.0	U
AI62-27	0.5	-0.6931	1.0	U
AI62-30	0.5	-0.6931	1.0	U
AI62-39	**4.7**	1.5476	1.0	
AI62-41	**120**	4.7875	1.0	
AI62-45	**1.8**	0.5878	1.0	
AI63-15	0.5	-0.6931	1.0	U
AI63-24	0.5	-0.6931	1.0	U
AI63-27	0.5	-0.6931	1.0	U
AI63-32	0.5	-0.6931	1.0	U
AI63-44	0.5	-0.6931	1.0	U
AI64-10	0.5	-0.6931	1.0	U

TABLE 5.19
CONCENTRATIONS OF TOTAL PCBs IN DEEP SOIL - EXCAVATION WORKER EXPOSURE

	Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual
AI64-15	0.5	-0.6931	1.0	U
AI64-26.5	0.5	-0.6931	1.0	U
AI64-31.5	0.5	-0.6931	1.0	U
AI64-36.5	**5**	1.6094	1.0	
AI64-41.5	0.5	-0.6931	1.0	U
AI64-44.5	0.5	-0.6931	1.0	U
AI65-15	0.5	-0.6931	1.0	U
AI65-26	0.5	-0.6931	1.0	U
AI65-30	0.5	-0.6931	1.0	U
AI65-35	0.5	-0.6931	1.0	U
AI65-40	**8.3**	2.1163	1.0	
AI65-46	**32**	3.4657	1.0	
AI66-10	0.5	-0.6931	1.0	U
AI66-30	0.5	-0.6931	1.0	U
AI66-35	0.5	-0.6931	1.0	U
AI66-40	0.5	-0.6931	1.0	U
AI66-42	**1.3**	0.2624	1.0	
AI66-44	**6.5**	1.8718	1.0	
AI66-47	**24**	3.1781	1.0	
AI66-50	**170**	5.1358	1.0	
AI67-13	0.5	-0.6931	1.0	U
AI67-29	0.5	-0.6931	1.0	U
AI67-34	0.5	-0.6931	1.0	U
AI67-39	0.5	-0.6931	1.0	U
AI67-44	0.5	-0.6931	1.0	U
AI67-46	**1.2**	0.1823	1.0	
AI67-48	0.5	-0.6931	1.0	U
AI68-11	0.5	-0.6931	1.0	U
AI68-19	0.5	-0.6931	1.0	U
AI68-24	0.5	-0.6931	1.0	U
AI68-29	**2.1**	0.7419	1.0	
AI68-34	0.5	-0.6931	1.0	U
AI68-39	0.5	-0.6931	1.0	U
AI68-44	0.5	-0.6931	1.0	U
AI68-45	0.5	-0.6931	1.0	U
AI69-10	0.5	-0.6931	1.0	U
AI69-15	0.5	-0.6931	1.0	U
AI69-20	0.5	-0.6931	1.0	U
AI69-25	0.5	-0.6931	1.0	U
AI69-30	0.5	-0.6931	1.0	U
AI69-35	0.5	-0.6931	1.0	U
AI69-40	0.5	-0.6931	1.0	U
AI69-42	0.5	-0.6931	1.0	U
AI69-44	0.5	-0.6931	1.0	U
AI69-46	0.5	-0.6931	1.0	U
AI70-10	0.5	-0.6931	1.0	U
AI70-15	0.5	-0.6931	1.0	U
AI70-20	0.5	-0.6931	1.0	U
AI70-30	0.5	-0.6931	1.0	U
AI70-35	0.5	-0.6931	1.0	U
AI70-40	0.5	-0.6931	1.0	U
AI70-45	0.5	-0.6931	1.0	U
AI70-47	0.5	-0.6931	1.0	U
AI70-49	0.5	-0.6931	1.0	U
AI70-51	**1**	0.0000	1.0	
AI70-52	**18**	2.8904	1.0	
AI71-10	0.5	-0.6931	1.0	U

TABLE 5.19
CONCENTRATIONS OF TOTAL PCBs IN DEEP SOIL - EXCAVATION WORKER EXPOSURE

	Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual
AI71-15	0.5	-0.6931	1.0	U
AI71-20	0.5	-0.6931	1.0	U
AI71-25	0.5	-0.6931	1.0	U
AI71-30	0.5	-0.6931	1.0	U
AI71-35	**2.5**	0.9163	1.0	
AI71-40	**7.9**	2.0669	1.0	
AI71-45	0.5	-0.6931	1.0	U
AI71-52	0.5	-0.6931	1.0	U
AI72-10	0.5	-0.6931	1.0	U
AI72-15	0.5	-0.6931	1.0	U
AI72-20	0.5	-0.6931	1.0	U
AI72-30	0.5	-0.6931	1.0	U
AI72-35	**3.6**	1.2809	1.0	
AI72-40	0.5	-0.6931	1.0	U
AI72-45	0.5	-0.6931	1.0	U
AI72-47	0.5	-0.6931	1.0	U
AI72-50	0.5	-0.6931	1.0	U
AI73-10	0.5	-0.6931	1.0	U
AI73-15	0.5	-0.6931	1.0	U
AI73-20	0.5	-0.6931	1.0	U
AI73-25	0.5	-0.6931	1.0	U
AI73-30	0.5	-0.6931	1.0	U
AI73-35	0.5	-0.6931	1.0	U
AI73-40	0.5	-0.6931	1.0	U
AI73-45	0.5	-0.6931	1.0	U
AI74-10	0.5	-0.6931	1.0	U
AI74-30	0.5	-0.6931	1.0	U
AI74-35	0.5	-0.6931	1.0	U
AI74-40	**1.5**	0.4055	1.0	
AI74-42	0.5	-0.6931	1.0	U
AI74-45	0.5	-0.6931	1.0	U
AI74-49	0.5	-0.6931	1.0	U
BHAIC95T9607-01-10	0.033	-3.4112		
BHAIC95T9607-01-15	0.033	-3.4112		
BHAIC95T9607-01-20	0.033	-3.4112		
BHAIC95T9607-01-25	0.033	-3.4112		
BHAIC95T9607-01-30	**0.127**	-2.0675		
BHAIC95T9607-01-35	0.033	-3.4112		
BHAIC95T9607-01-40	0.033	-3.4112		
BHAIC95T9607-01-45	0.033	-3.4112		
BHAIC95T9607-01-50	0.033	-3.4112		
BHAIC95T9607-01-53	0.033	-3.4112		
BHAIC95T9607-02-11	0.033	-3.4112		
BHAIC95T9607-02-16	0.033	-3.4112		
BHAIC95T9607-02-21	0.033	-3.4112		
BHAIC95T9607-02-31	0.033	-3.4112		
BHAIC95T9607-02-36	0.033	-3.4112		
BHAIC95T9607-02-41	0.033	-3.4112		
BHAIC95T9607-02-46	0.033	-3.4112		
BHAIC95T9607-02-51	0.033	-3.4112		
BHAIC95T9607-02-54	0.033	-3.4112		
BHAIC95T9607-03-11	0.033	-3.4112		
BHAIC95T9607-03-16	0.033	-3.4112		
BHAIC95T9607-03-21	0.033	-3.4112		
BHAIC95T9607-03-26	0.033	-3.4112		
BHAIC95T9607-03-31	0.033	-3.4112		
BHAIC95T9607-03-36	**1.58**	0.4574		

TABLE 5.19
CONCENTRATIONS OF TOTAL PCBs IN DEEP SOIL - EXCAVATION WORKER EXPOSURE

	Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual
BHAIC95T9607-03-41	**0.287**	-1.2483		
BHAIC95T9607-03-46	**0.157**	-1.8515		
BHAIC95T9607-03-49	**6900**	8.8393		
BHAIC95T9610-01-10	0.033	-3.4112		
BHAIC95T9610-01-15	0.033	-3.4112		
BHAIC95T9610-01-20	0.033	-3.4112		
BHAIC95T9610-01-25	0.33	-1.1087		
BHAIC95T9610-01-30	0.033	-3.4112		
BHAIC95T9610-01-35	0.033	-3.4112		
BHAIC95T9610-01-40	0.033	-3.4112		
BHAIC95T9610-01-45	0.033	-3.4112		
BHAIC95T9610-01-48	0.033	-3.4112		
BHAIC95T9610-02-10	0.033	-3.4112		
BHAIC95T9610-02-15	0.033	-3.4112		
BHAIC95T9610-02-20	0.033	-3.4112		
BHAIC95T9610-02-25	0.033	-3.4112		
BHAIC95T9610-02-30	0.033	-3.4112		
BHAIC95T9610-02-35	0.033	-3.4112		
BHAIC95T9610-02-40	0.033	-3.4112		
BHAIC95T9610-02-45	0.033	-3.4112		
BHAIC95T9610-02-47	0.032	-3.4420		
BHAIC95T9807-06-12	0.0495	-3.0058		
BHAIC95T9807-06-15	0.0495	-3.0058		
BHAIC95T9807-06-19	0.0495	-3.0058		
BHAIC95T9807-06-22	0.0495	-3.0058		
BHAIC95T9807-06-27	**0.073**	-2.6173		
BHAIC95T9807-06-32	0.0495	-3.0058		
BHAIC95T9807-06-37	**0.721**	-0.3271		
BHAIC95T9807-06-41	0.0495	-3.0058		
BHAIC95T9808-01-12	**0.0725**	-2.6242		
KC98-233-980804-10	**2.580**	0.9478		
KC98-233-980804-15	**0.16**	-1.8326		
KC98-233-980804-20	0.16	-1.8326		
KC98-233-980804-25	0.16	-1.8326		
Number	262			
Minimum Detection	0.09			
Maximum Detection	6900			
Average	91	-0.687		
Standard Deviation	691	2.337		
H Statistic		3.586		
95% UCL		13		
RME		13		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected concentration
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.
Note: Concentrations shown for samples AI15 through AI74 are lab reported concentrations. Concentrations for samples BHAIC95T through KC98-233 were estimated using detected concentrations and half reporting limits from Table 5.18.

TABLE 5.20
CONCENTRATIONS OF PCBS IN SHALLOW SOILS - UTILITY WORKER EXPOSURES

	Aroclor - 1242 (ug/kg)				Aroclor - 1248			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
BHAIC95T9607-01-05	17.5	2.8622	35	U	17.5	2.8622	35	U
BHAIC95T9607-01-10	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9607-02-06	165	5.1059	330	U	165	5.1059	330	U
BHAIC95T9607-03-6	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9610-01-05	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9610-01-10	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9610-02-05	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9610-02-10	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9807-06-07	16.5	2.8034	33	U	16.5	2.8034	33	U
KC98-233-980804-05	80	4.3820	160	U	**2700**	7.9010	160	
KC98-233-980804-10	80	4.3820	160	U	**2500**	7.8240	160	
BHAIC95T9808-01-06	16.5	2.8034	33	U	16.5	2.8034	33	U
BHAIC95T9808-02-06	**2500**	7.8240	160		80	4.3820	160	U
BHAIC95T9808-03-06	**29000**	10.2751	16000		8000	8.9872	16000	U
SSAIC95T990812-01-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-18-01	**660**	6.4922	330		165	5.1059	330	U
SSAIC95T990812-17-01	**410**	6.0162	330		165	5.1059	330	U
SSAIC95T990812-14-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-13-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-12-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-11-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-10-01	160	5.0752	320	U	160	5.0752	320	U
SSAIC95T990812-09-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-08-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-07-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-16-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-15-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-06-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-05-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-04-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-03-01	165	5.1059	330	U	165	5.1059	330	U
SSAIC95T990812-02-01	165	5.1059	330	U	165	5.1059	330	U
Number	32				32			
Minimum Detection	410				2500			
Maximum Detection	29,000				2700			
Average	1115	4.73			517	4.73		
Standard Deviation	5107	1.62			1497	1.54		
H Statistic		3.243				3.066		
95% UCL		1072				870		
RME		1072				870		

RL = Laboratory reporting limit

RME = Lower of 95% UCL or maximum detected

J = Estimated value below reporting limit or estimated based on data quality review

U = Analyte not detected. Value shown is one-half the reporting limit.

Bold = Analyte detected in sample

Log result is the natural logarithm of the result: used to calculate the 95% UCL of the mean.

95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.

TABLE 5.20
CONCENTRATIONS OF PCBS IN SHALLOW SOILS - UTILITY WORKER EXPOSURES

	Aroclor - 1260			
Sample ID	Result	Log Result	RL	Qual
BHAIC95T9607-01-05	17.5	2.8622	35	U
BHAIC95T9607-01-10	16.5	2.8034	33	U
BHAIC95T9607-02-06	165	5.1059	330	U
BHAIC95T9607-03-6	16.5	2.8034	33	U
BHAIC95T9610-01-05	16.5	2.8034	33	U
BHAIC95T9610-01-10	16.5	2.8034	33	U
BHAIC95T9610-02-05	16.5	2.8034	33	U
BHAIC95T9610-02-10	16.5	2.8034	33	U
BHAIC95T9807-06-07	16.5	2.8034	33	U
KC98-233-980804-05	80	4.3820	160	U
KC98-233-980804-10	80	4.3820	160	U
BHAIC95T9808-01-06	**63**	4.1431	33	
BHAIC95T9808-02-06	80	4.3820	160	U
BHAIC95T9808-03-06			16000	U
SSAIC95T990812-01-01			330	U
SSAIC95T990812-18-01			330	U
SSAIC95T990812-17-01			330	U
SSAIC95T990812-14-01			330	U
SSAIC95T990812-13-01			330	U
SSAIC95T990812-12-01			330	U
SSAIC95T990812-11-01			330	U
SSAIC95T990812-10-01			320	U
SSAIC95T990812-09-01			330	U
SSAIC95T990812-08-01			330	U
SSAIC95T990812-07-01			330	U
SSAIC95T990812-16-01			330	U
SSAIC95T990812-15-01			330	U
SSAIC95T990812-06-01			330	U
SSAIC95T990812-05-01			330	U
SSAIC95T990812-04-01			330	U
SSAIC95T990812-03-01			330	U
SSAIC95T990812-02-01			330	U
Number	13			
Minimum Detection	63			
Maximum Detection	63			
Average	46	3.45		
Standard Deviation	45	0.87		
H Statistic		2.607		
95% UCL		89		
RME		63		

TABLE 5.21
CONCENTRATIONS OF PCBS IN SHALLOW SOILS - UTILITY WORKER EXPOSURE

	Total PCBs (ug/kg)			
Sample ID	Result	Log Result	RL	Qual
AI15-6	500	6.2146	1000	U
AI15-9	500	6.2146	1000	U
AI16-6	500	6.2146	1000	U
AI16-9	500	6.2146	1000	U
AI17-6	500	6.2146	1000	U
AI18-6	500	6.2146	1000	U
AI18-9	500	6.2146	1000	U
AI19-6	**90**	4.4998	160	J
AI19-9	500	6.2146	1000	U
AI45-5	500	6.2146	1000	U
AI45-10	500	6.2146	1000	U
AI48-5	500	6.2146	1000	U
AI48-10	500	6.2146	1000	U
AI48-10	500	6.2146	1000	U
AI49-5	**1000**	6.9078	1000	
AI49-10	500	6.2146	1000	U
AI50-6	500	6.2146	1000	U
AI52-5	**46000**	10.7364	1000	
AI52-9	**9000**	9.1050	1000	
AI53-10	**1300**	7.1701	1000	
AI54-5	**2000**	7.6009	1000	
AI54-10	**1100**	7.0031	1000	
AI55-5	500	6.2146	1000	U
AI55-10	**2000**	7.6009	1000	
AI56-7	500	6.2146	1000	U
AI57-9	**1500**	7.3132	1000	
AI58-9	500	6.2146	1000	U
AI59-9	500	6.2146	1000	U
AI60-9	**3900**	8.2687	1000	
AI61-4.5	500	6.2146	1000	U
AI62-7	500	6.2146	1000	U
AI63-4	500	6.2146	1000	U
AI64-3.5	500	6.2146	1000	U
AI64-10	500	6.2146	1000	U
AI65-5	500	6.2146	1000	U
AI65-9	500	6.2146	1000	U
AI66-5	500	6.2146	1000	U
AI66-10	500	6.2146	1000	U
AI67-4	500	6.2146	1000	U
AI67-9	500	6.2146	1000	U
AI68-2	500	6.2146	1000	U
AI68-7	**19000**	9.8522	1000	
AI69-4	500	6.2146	1000	U
AI69-10	500	6.2146	1000	U
AI70-5	500	6.2146	1000	U
AI70-10	500	6.2146	1000	U
AI71-5	500	6.2146	1000	U
AI71-10	500	6.2146	1000	U
AI72-5	500	6.2146	1000	U
AI72-10	500	6.2146	1000	U
AI73-10	500	6.2146	1000	U
AI74-10	500	6.2146	1000	U
AI46-5	**23000**	10.0432	1000	
AI46-10	**31000**	10.3417	1000	
BHAIC95T9607-01-05	52.5	3.9608		

TABLE 5.21
CONCENTRATIONS OF PCBS IN SHALLOW SOILS - UTILITY WORKER EXPOSURE

	Total PCBs (ug/kg)			
Sample ID	Result	Log Result	RL	Qual
BHAIC95T9607-01-10	49.5	3.9020		
BHAIC95T9607-02-06	495	6.2046		
BHAIC95T9607-03-6	49.5	3.9020		
BHAIC95T9610-01-05	49.5	3.9020		
BHAIC95T9610-01-10	49.5	3.9020		
BHAIC95T9610-02-05	49.5	3.9020		
BHAIC95T9610-02-10	49.5	3.9020		
BHAIC95T9807-06-07	49.5	3.9020		
KC98-233-980804-05	**2860**	7.9586		
KC98-233-980804-10	**2660**	7.8861		
BHAIC95T9808-01-06	**96**	4.5643		
BHAIC95T9808-02-06	**2660**	7.8861		
BHAIC95T9808-03-06	**37000**	10.5187		
SSAIC95T990812-01-01	330	5.7991		
SSAIC95T990812-18-01	**825**	6.7154		
SSAIC95T990812-17-01	**426**	6.0544		
SSAIC95T990812-14-01	330	5.7991		
SSAIC95T990812-13-01	330	5.7991		
SSAIC95T990812-12-01	330	5.7991		
SSAIC95T990812-11-01	330	5.7991		
SSAIC95T990812-10-01	320	5.7683		
SSAIC95T990812-09-01	330	5.7991		
SSAIC95T990812-08-01	330	5.7991		
SSAIC95T990812-07-01	330	5.7991		
SSAIC95T990812-16-01	330	5.7991		
SSAIC95T990812-15-01	330	5.7991		
SSAIC95T990812-06-01	330	5.7991		
SSAIC95T990812-05-01	330	5.7991		
SSAIC95T990812-04-01	330	5.7991		
SSAIC95T990812-03-01	330	5.7991		
SSAIC95T990812-02-01	330	5.7991		
Number	86			
Minimum Detection	90			
Maximum Detection	46000			
Average	2489	6.31		
Standard Deviation	7630	1.38		
H Statistic		2.577		
95% UCL		2116		
RME		2116		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result: used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.
Note: Concentrations shown for the AI samples are lab reported concentrations.
and one-half reporting limits from Table 5.20.

TABLE 5.22
CONCENTRATIONS OF PCBs IN SEDIMENTS - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/kg)				Aroclor - 1248 (ug/kg)				Aroclor - 1260 (ug/kg)				Total PCBs (ug/kg)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-000126-02	75	4.3175	150	U	75	4.3175	150	U	75	4.3175	150	U	225	5.4161		
OF002-000202-02	48.5	3.8816	97	U	48.5	3.8816	97	U	48.5	3.8816	97	U	145.5	4.9802		
OF002-000223-02	60	4.0943	120	U	**400**	5.9915	120		60	4.0943	120	U	**520**	6.2538		
OF002-000405-02	**210**	5.3471	82		41	3.7136	82	U	41	3.7136	82	U	**292**	5.6768		
OF002-991019-03	2000	7.6009	4000	U	2000	7.6009	4000	U	2000	7.6009	4000	U	6000	8.6995		
OF002-991215-02	**1100**	7.0031	210		105	4.6540	210	U	105	4.6540	210	U	**1310**	7.1778		
OF002-991222-02	75	4.3175	150	U	75	4.3175	150	U	75	4.3175	150	U	225	5.4161		
SD002RAC981030-01-02	**280**	5.6348	33		16.5	2.8034	33	U	16.5	2.8034	33	U	**313**	5.7462		
SD002RAC981030-02-02	**670**	6.5073	330		165	5.1059	330	U	165	5.1059	330	U	**1000**	6.9078		
SDAIC95T980709-03-01	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	2.8034	33	U	49.5	3.9020		
SDAIC95T980709-04-01	**480**	6.1738	160		80	4.3820	160	U	80	4.3820	160	U	**640**	6.4615		
SDAIC95T980709-05-01	**2300**	7.7407	160		80	4.3820	160	U	80	4.3820	160	U	**2460**	7.8079		
SDAIC95T980709-06-01	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	2.8034	33	U	49.5	3.9020		
SDAIC95T980710-02-01	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	2.8034	33	U	49.5	3.9020		
SDAIC95T980710-03-01	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	2.8034	33	U	49.5	3.9020		
SDAIC95T980710-04-01	16.5	2.8034	33	U	16.5	2.8034	33	U	16.5	2.8034	33	U	49.5	3.9020		
SDAIC95T980918-01-01	165	5.1059	330	U	165	5.1059	330	U	165	5.1059	330	U	495	6.2046		
SDAIC95T981015-01-01	**16000**	9.6803	3300		1650	7.4085	3300	U	1650	7.4085	3300	U	**19300**	9.8679		
SDAIC95T981106-02-01	**5700**	8.6482	3300		1650	7.4085	3300	U	1650	7.4085	3300	U	**9000**	9.1050		
SDAIC95T981106-04-01	**6900**	8.8393	6600		3300	8.1017	6600	U	3300	8.1017	6600	U	**13500**	9.5104		
SDAIC95T981106-06-01	**2100**	7.6497	1600		800	6.6846	1600	U	800	6.6846	1600	U	**3700**	8.2161		
SDAIC95T981106-07-01	**71000**	11.1704	33000		16500	9.7111	33000	U	16500	9.7111	33000	U	**104000**	11.5521		
SDAIC95T981106-08-01	**160**	5.0752	160		80	4.3820	160	U	80	4.3820	160	U	**320**	5.7683		
SDAIC95T990721-21-01	**17000**	9.7410	3300		1650	7.4085	3300	U	1650	7.4085	3300	U	**20300**	9.9184		
SDAIC95T990721-22-01	**12000000**	16.3004	2800000				2800000	U			2800000	U	**12000000**	16.3004		
SDAIC95T990721-23-01	**1300**	7.1701	320		160	5.0752	320	U	160	5.0752	320	U	**1620**	7.3902		
SDAIC95T990721-24-01	165	5.1059	330	U	165	5.1059	330	U	165	5.1059	330	U	495	6.2046		
SDAIC95T990721-25-01	**350000**	12.7657	120000				120000	U			120000	U	**350000**	12.7657		
SDAIC95T990721-26-01	**420000**	12.9480	81000		40500	10.6091	81000	U	40500	10.6091	81000	U	**501000**	13.1244		
SDAIC95T990721-27-01	165	5.1059	330	U	165	5.1059	330	U	**960**	6.8669	330		1290	7.1624		
SDAIC95T990721-28-01	265	5.5797	530	U	265	5.5797	530	U	**6800**	8.8247	530		7330	8.8997		
SDAIC95T990721-29-01	165	5.1059	330	U	165	5.1059	330	U	165	5.1059	330	U	495	6.2046		
SDAIC95T990721-30-01	160	5.0752	320	U	160	5.0752	320	U	160	5.0752	320	U	480	6.1738		
SDAIC95T990721-31-01	165	5.1059	330	U	**500**	6.2146	330		165	5.1059	330	U	**830**	6.7214		
SDAIC95T990721-32-01	165	5.1059	330	U	**440**	6.0868	330		165	5.1059	330	U	**770**	6.6464		
SDAIC95T990721-33-01	315	5.7526	630	U	**3000**	8.0064	630		315	5.7526	630	U	**3630**	8.1970		
SDAIC95T990812-01-01	165	5.1059	330	U	165	5.1059	330	U	165	5.1059	330	U	495	6.2046		

TABLE 5.22
CONCENTRATIONS OF PCBs IN SEDIMENTS - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/kg)				Aroclor - 1248 (ug/kg)				Aroclor - 1260 (ug/kg)				Total PCBs (ug/kg)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
SDAIC95T990812-02-01	160	5.0752	320	U	160	5.0752	320	U	160	5.0752	320	U	480	6.1738		
SDAIC95T990812-03-01	**830**	6.7214	330		165	5.1059	330	U	165	5.1059	330	U	**1160**	7.0562		
SDAIC95T990812-04-01	**570**	6.3456	330		165	5.1059	330	U	165	5.1059	330	U	**900**	6.8024		
SDAIC95T990812-05-01	160	5.0752	320	U	160	5.0752	320	U	160	5.0752	320	U	480	6.1738		
SSAIC95T990812-17-01	**410**	6.0162	330		165	5.1059	330	U	165	5.1059	330	U	NA			
SSAIC95T990812-18-01	**660**	6.4922	330		165	5.1059	330	U	165	5.1059	330	U	NA			
Number	43				41				41				41			
Minimum Detection	160				400				960				292			
Maximum Detection	12,000,000				3000				6800				13400000			
Average	300052	6.38			1845	5.34			1935	5.31			318426	7.28		
Standard Deviation	1828565	2.89			6721	1.82			6765	1.87			1872354	2.65		
H Statistic		5.115				3.465				3.465				4.777		
95% UCL		371164				2976				3251				354628		
RME		371164				2976				3251				354628		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
NA = Not Analyzed For
Bold = Analyte detected in sample
Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.
Note: Total PCB concentrations were estimated using the individual mixtures data, including one-half reporting limits for nondetects. Bold values included detected concentrations in the calculations.

TABLE 5.23
CONCENTRATIONS OF PCBs IN SEDIMENTS - RECREATIONAL RECEPTOR EXPOSURE

	Aroclor - 1242 (ug/kg)				Aroclor - 1248 (ug/kg)				Total PCBs (ug/kg)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result		RL	Qual
OF002-000126-02	75	4.3175	150	U	75	4.3175	150	U	150	5.0106		U
OF002-000202-02	48.5	3.8816	97	U	48.5	3.8816	97	U	97	4.5747		U
OF002-000223-02	60	4.0943	120	U	**400**	5.9915	120		**460**	6.1312		
OF002-000405-02	**210**	5.3471	82		41	3.7136	82	U	**251**	5.5255		
OF002-991019-03	2000	7.6009	4000	U	2000	7.6009	4000	U	4000	8.2940		U
OF002-991215-02	**1100**	7.0031	210		105	4.6540	210	U	**1205**	7.0942		
OF002-991222-02	75	4.3175	150	U	75	4.3175	150	U	150	5.0106		U
SDAIC95T980709-03-01	16.5	2.8034	33	U	16.5	2.8034	33	U	33	3.4965		U
SDAIC95T980709-04-01	**480**	6.1738	160		80	4.3820	160	U	**560**	6.3279		
SDAIC95T980709-05-01	**2300**	7.7407	160		80	4.3820	160	U	**2380**	7.7749		
SDAIC95T980709-06-01	16.5	2.8034	33	U	16.5	2.8034	33	U	33	3.4965		U
SDAIC95T980710-02-01	16.5	2.8034	33	U	16.5	2.8034	33	U	33	3.4965		U
SDAIC95T980710-03-01	16.5	2.8034	33	U	16.5	2.8034	33	U	33	3.4965		U
SDAIC95T980710-04-01	16.5	2.8034	33	U	16.5	2.8034	33	U	33	3.4965		U
SSAIC95T990812-17-01	**410**	6.0162	330		165.0	5.1059	330	U	NA			
SSAIC95T990812-18-01	**660**	6.4922	330		165.0	5.1059	330	U	NA			
Number	16				16				14			
Minimum Detection	210				400				251			
Maximum Detection	2300				400				2380			
Average	469	4.813			207	4.217			673	5.230		
Standard Deviation	725	1.819			488	1.337			1158	1.687		
H Statistic		4.222				3.337				3.947		
95% UCL		4670				524				4915		
RME		2300				400				2380		

RL = Laboratory reporting limit
RME = Lower of 95 % UCL or the maximum detected concentration
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.
Note: Total PCB concentrations were estimated using the individual Aroclor mixture data. The concentrations include the use of one half the reporting limit of nondetect samples. Bold values included detected concentrations in the calculation.

TABLE 5.24
CONCENTRATIONS OF PCBs IN SURFACE WATER - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
BHAIC95T9808-02-01	**4.50**	1.50	0.10		0.05	-3.00	0.10	U					**4.55**	1.52		
BHAIC95T9808-03-01	**4.50**	1.50	0.10		0.05	-3.00	0.10	U					**4.55**	1.52		
OF002-000103-01	**0.35**	-1.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.45**	-0.80		
OF002-000105-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000112-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000119-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000126-01	**0.18**	-1.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.28**	-1.27		
OF002-000202-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000209-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000216-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000218-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000223-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000301-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000308-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000316-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000322-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000329-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000330-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000405-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000412-01	**0.15**	-1.90	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.25**	-1.39		
OF002-000419-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000426-01	**0.15**	-1.90	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.25**	-1.39		
OF002-950310-01	**1.2**	0.18	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.30**	0.26		
OF002-950311-01	**0.74**	-0.30	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.84**	-0.17		
OF002-950312-01	**0.9**	-0.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.00**	0.00		
OF002-950313-01	**1.1**	0.10	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.20**	0.18		
OF002-950314-01	**1.2**	0.18	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.30**	0.26		
OF002-950315-01	**1.5**	0.41	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.60**	0.47		
OF002-950316-02	**1.4**	0.34	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.50**	0.41		
OF002-950317-01	**0.88**	-0.13	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.98**	-0.02		
OF002-950318-01	**0.16**	-1.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.26**	-1.35		
OF002-950319-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-950320-01	**0.75**	-0.29	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.85**	-0.16		
OF002-950620-01	**0.94**	-0.06	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.04**	0.04		
OF002-951121-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.42**	-0.87		
OF002-951128-01	**0.24**	-1.43	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.34**	-1.08		

TABLE 5.24
CONCENTRATIONS OF PCBs IN SURFACE WATER - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-951205-01	**0.35**	-1.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.45**	-0.80		
OF002-951219-01	**0.17**	-1.77	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.27**	-1.31		
OF002-960103-01	**0.27**	-1.31	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.37**	-0.99		
OF002-960116-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-960206-01	**0.12**	-2.12	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.22**	-1.51		
OF002-960220-01	**0.26**	-1.35	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.36**	-1.02		
OF002-960305-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-960319-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-960402-01	**0.57**	-0.56	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.67**	-0.40		
OF002-960416-01	**0.16**	-1.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.26**	-1.35		
OF002-960514-01	**0.56**	-0.58	0.50		0.025	-3.69	0.50	U	0.025	-3.69	0.50	U	**0.61**	-0.49		
OF002-960521-01	**0.41**	-0.89	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.51**	-0.67		
OF002-960604-01	**0.72**	-0.33	0.50		0.025	-3.69	0.50	U	0.025	-3.69	0.50	U	**0.77**	-0.26		
OF002-960618-01	**0.58**	-0.54	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.68**	-0.39		
OF002-960702-01	**0.54**	-0.62	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.64**	-0.45		
OF002-960716-01	**0.85**	-0.16	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.95**	-0.05		
OF002-960730-01	0.05	-3.00	0.10	U	**7.6**	2.03	0.10		0.05	-3.00	0.10	U	**7.70**	2.04		
OF002-960806-01	**1**	0.00	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.10**	0.10		
OF002-960820-01	**0.6**	-0.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.70**	-0.36		
OF002-960904-01	**0.39**	-0.94	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.49**	-0.71		
OF002-960918-01	**0.6**	-0.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.70**	-0.36		
OF002-961009-01	**0.44**	-0.82	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.54**	-0.62		
OF002-961022-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-961106-01	**0.54**	-0.62	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.64**	-0.45		
OF002-961119-01	**0.33**	-1.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.43**	-0.84		
OF002-961203-01	**0.21**	-1.56	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.31**	-1.17		
OF002-961212-01	**0.12**	-2.12	0.10		0.05	-3.00	0.10	U	**0.14**	-1.97	0.10		**0.31**	-1.17		
OF002-961212-02	**0.49**	-0.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.59**	-0.53		
OF002-961217-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-970107-01	**0.51**	-0.67	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.61**	-0.49		
OF002-970121-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-970204-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-970218-01	**0.37**	-0.99	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.47**	-0.76		
OF002-970304-01	**0.84**	-0.17	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.94**	-0.06		
OF002-970312-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-970318-01	**0.53**	-0.63	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.63**	-0.46		

TABLE 5.24
CONCENTRATIONS OF PCBs IN SURFACE WATER - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-970408-01	**0.69**	-0.37	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.79**	-0.24		
OF002-970422-01	**0.64**	-0.45	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.74**	-0.30		
OF002-970430-01	**0.54**	-0.62	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.64**	-0.45		
OF002-970506-01	**0.93**	-0.07	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.03**	0.03		
OF002-970520-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-970603-01	**0.53**	-0.63	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.63**	-0.46		
OF002-970624-01	**0.69**	-0.37	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.79**	-0.24		
OF002-970708-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-970723-01	**0.83**	-0.19	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.93**	-0.07		
OF002-970805-01	**0.36**	-1.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.46**	-0.78		
OF002-970826-01	**0.59**	-0.53	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.69**	-0.37		
OF002-970903-01	**0.67**	-0.40	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.77**	-0.26		
OF002-970926-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-971007-01	**0.88**	-0.13	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.98**	-0.02		
OF002-971028-01	**0.73**	-0.31	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.83**	-0.19		
OF002-971104-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-971118-01	**0.33**	-1.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.43**	-0.84		
OF002-971128-01	**0.16**	-1.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.26**	-1.35		
OF002-971128-02	**0.18**	-1.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.28**	-1.27		
OF002-971209-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-971216-01	**0.33**	-1.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.43**	-0.84		
OF002-980106-01	**0.52**	-0.65	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.62**	-0.48		
OF002-980120-01	**0.55**	-0.60	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.65**	-0.43		
OF002-980203-01	**0.72**	-0.33	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.82**	-0.20		
OF002-980217-01	**0.27**	-1.31	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.37**	-0.99		
OF002-980303-01	**0.47**	-0.76	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.57**	-0.56		
OF002-980324-01	**0.96**	-0.04	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.06**	0.06		
OF002-980407-01	**0.8**	-0.22	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.90**	-0.11		
OF002-980421-01	**0.72**	-0.33	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.82**	-0.20		
OF002-980505-01	**0.82**	-0.20	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.92**	-0.08		
OF002-980519-01	**0.77**	-0.26	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.87**	-0.14		
OF002-980602-01	**0.78**	-0.25	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.88**	-0.13		
OF002-980616-01	**0.49**	-0.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.59**	-0.53		
OF002-980707-01	**0.62**	-0.48	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.72**	-0.33		
OF002-980721-01	**0.57**	-0.56	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.67**	-0.40		
OF002-980804-01	**0.78**	-0.25	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.88**	-0.13		

TABLE 5.24
CONCENTRATIONS OF PCBs IN SURFACE WATER - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-980818-01	**0.98**	-0.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.08**	0.08		
OF002-980826-02	**0.96**	-0.04	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.06**	0.06		
OF002-980827-01	**0.35**	-1.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.45**	-0.80		
OF002-980909-01	**0.84**	-0.17	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.94**	-0.06		
OF002-980929-01	**0.36**	-1.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.46**	-0.78		
OF002-981008-01	**0.65**	-0.43	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.75**	-0.29		
OF002-981020-01	**0.8**	-0.22	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.90**	-0.11		
OF002-981113-01	**0.7**	-0.36	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.80**	-0.22		
OF002-981117-01	**0.65**	-0.43	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.75**	-0.29		
OF002-981211-01	**0.68**	-0.39	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.78**	-0.25		
OF002-990108-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-990112-01	**1.2**	0.18	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.30**	0.26		
OF002-990119-01	**1**	0.00	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.10**	0.10		
OF002-990122-01	**0.28**	-1.27	0.10	J	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-990123-01	**0.66**	-0.42	0.10	J	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.76**	-0.27		
OF002-990124-01	**0.65**	-0.43	0.10	J	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.75**	-0.29		
OF002-990202-01	**0.62**	-0.48	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.72**	-0.33		
OF002-990216-01	**0.95**	-0.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.05**	0.05		
OF002-990302-01	**0.87**	-0.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.97**	-0.03		
OF002-990316-01	**0.45**	-0.80	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.55**	-0.60		
OF002-990407-01	**0.58**	-0.54	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.68**	-0.39		
OF002-990420-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-990511-01	**0.45**	-0.80	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.55**	-0.60		
OF002-990525-01	**0.37**	-0.99	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.47**	-0.76		
OF002-990608-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-990622-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-990707-01	**0.62**	-0.48	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.72**	-0.33		
OF002-990720-01	**0.23**	-1.47	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.33**	-1.11		
OF002-990722-01	**0.29**	-1.24	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.39**	-0.94		
OF002-990803-01	**0.44**	-0.82	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.54**	-0.62		
OF002-990805-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-990818-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-990820-01	**0.17**	-1.77	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.27**	-1.31		
OF002-990825-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-990908-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-990930-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.42**	-0.87		

TABLE 5.24
CONCENTRATIONS OF PCBs IN SURFACE WATER - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-991005-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.42**	-0.87		
OF002-991012-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-991012-02	**0.3**	-1.20	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.40**	-0.92		
OF002-991019-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-991026-02	**0.23**	-1.47	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.33**	-1.11		
OF002-991103-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991110-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991117-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991124-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991125-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991201-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991208-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991215-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-991222-01	**0.47**	-0.76	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.57**	-0.56		
OF002-991229-01	**0.12**	-2.12	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.22**	-1.51		
SD002RAC981030-01-01	**28**	3.33	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**28.10**	3.34		
SD002RAC981030-02-01	**46**	3.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**46.10**	3.83		
SDAIC000980804-01-01	**0.40**	-0.92	0.10		0.05	-3.00	0.10	U					**0.45**	-0.80		
SDAIC000980818-02-01	**1.10**	0.10	0.10		0.05	-3.00	0.10	U					**1.15**	0.14		
SDAIC000980818-03-01	**0.27**	-1.31	0.10		0.05	-3.00	0.10	U					**0.32**	-1.14		
SDAIC95T981106-01-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
SDAIC95T981106-03-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
SDAIC95T981106-09-01	**27**	3.30	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**27.10**	3.30		
SDAICO00980616-02-01	**0.36**	-1.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.46**	-0.78		
SDAICO00980707-02-01	**1.30**	0.26	0.10		0.05	-3.00	0.10	U	**0.76**	-0.27	0.10		**2.11**	0.75		
SDAICO00980721-02-01	**0.29**	-1.24	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.39**	-0.94		
SDSLGATE980804-01-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U					**0.37**	-0.99		
SDSLGATE980818-01-01	**0.81**	-0.21	0.10		0.05	-3.00	0.10	U					**0.86**	-0.15		
SWBRU-980602-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
SWICBR-980602-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
SWICDB-980602-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		

TABLE 5.24
CONCENTRATIONS OF PCBs IN SURFACE WATER - CONSTRUCTION WORKER EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
Number	174				175				168				175			
Minimum Detection	0.12				7.6				0.14				0.07			
Maximum Detection	46				7.6				0.76				46.10			
Average	1.07	-1.06			0.09	-2.97			0.05	-2.98			1.21	-0.67		
Standard Deviation	4.51	1.19			0.57	0.39			0.06	0.24			4.53	0.91		
H Statistic		2.447				1.777				1.714				2.117		
95% UCL		0.875				0.058				0.054				0.898		
RME		0.875				0.058				0.054				0.898		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.
Note: Total PCB concentrations were estimated using the individual mixture data, including one-half reporting limits for nondetects.

TABLE 5.25
CONCENTRATIONS OF PCBs IN SURFACE WATER - RECREATIONAL RECEPTOR EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-000103-01	**0.35**	-1.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.45**	-0.80		
OF002-000105-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000112-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000119-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000126-01	**0.18**	-1.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.28**	-1.27		
OF002-000202-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000209-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000216-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000218-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000223-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000301-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000308-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000316-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000322-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000329-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000330-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000405-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000412-01	**0.15**	-1.90	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.25**	-1.39		
OF002-000419-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-000426-01	**0.15**	-1.90	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.25**	-1.39		
OF002-950310-01	**1.2**	0.18	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.30**	0.26		
OF002-950311-01	**0.74**	-0.30	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.84**	-0.17		
OF002-950312-01	**0.9**	-0.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.00**	0.00		
OF002-950313-01	**1.1**	0.10	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.20**	0.18		
OF002-950314-01	**1.2**	0.18	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.30**	0.26		
OF002-950315-01	**1.5**	0.41	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.60**	0.47		
OF002-950316-02	**1.4**	0.34	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.50**	0.41		
OF002-950317-01	**0.88**	-0.13	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.98**	-0.02		
OF002-950318-01	**0.16**	-1.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.26**	-1.35		
OF002-950319-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-950320-01	**0.75**	-0.29	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.85**	-0.16		
OF002-950620-01	**0.94**	-0.06	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.04**	0.04		
OF002-951121-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.42**	-0.87		
OF002-951128-01	**0.24**	-1.43	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.34**	-1.08		
OF002-951205-01	**0.35**	-1.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.45**	-0.80		
OF002-951219-01	**0.17**	-1.77	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.27**	-1.31		

TABLE 5.25
CONCENTRATIONS OF PCBs IN SURFACE WATER - RECREATIONAL RECEPTOR EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-960103-01	**0.27**	-1.31	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.37**	-0.99		
OF002-960116-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-960206-01	**0.12**	-2.12	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.22**	-1.51		
OF002-960220-01	**0.26**	-1.35	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.36**	-1.02		
OF002-960305-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-960319-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-960402-01	**0.57**	-0.56	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.67**	-0.40		
OF002-960416-01	**0.16**	-1.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.26**	-1.35		
OF002-960514-01	**0.56**	-0.58	0.50		0.025	-3.69	0.50	U	0.025	-3.69	0.50	U	**0.61**	-0.49		
OF002-960521-01	**0.41**	-0.89	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.51**	-0.67		
OF002-960604-01	**0.72**	-0.33	0.50		0.025	-3.69	0.50	U	0.025	-3.69	0.50	U	**0.77**	-0.26		
OF002-960618-01	**0.58**	-0.54	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.68**	-0.39		
OF002-960702-01	**0.54**	-0.62	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.64**	-0.45		
OF002-960716-01	**0.85**	-0.16	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.95**	-0.05		
OF002-960730-01	0.05	-3.00	0.10	U	**7.6**	2.03	0.10		0.05	-3.00	0.10	U	**7.70**	2.04		
OF002-960806-01	**1**	0.00	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.10**	0.10		
OF002-960820-01	**0.6**	-0.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.70**	-0.36		
OF002-960904-01	**0.39**	-0.94	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.49**	-0.71		
OF002-960918-01	**0.6**	-0.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.70**	-0.36		
OF002-961009-01	**0.44**	-0.82	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.54**	-0.62		
OF002-961022-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-961106-01	**0.54**	-0.62	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.64**	-0.45		
OF002-961119-01	**0.33**	-1.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.43**	-0.84		
OF002-961203-01	**0.21**	-1.56	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.31**	-1.17		
OF002-961212-01	**0.12**	-2.12	0.10		0.05	-3.00	0.10	U	**0.14**	-1.97	0.10		**0.31**	-1.17		
OF002-961212-02	**0.49**	-0.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.59**	-0.53		
OF002-961217-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-970107-01	**0.51**	-0.67	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.61**	-0.49		
OF002-970121-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-970204-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-970218-01	**0.37**	-0.99	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.47**	-0.76		
OF002-970304-01	**0.84**	-0.17	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.94**	-0.06		
OF002-970312-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-970318-01	**0.53**	-0.63	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.63**	-0.46		
OF002-970408-01	**0.69**	-0.37	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.79**	-0.24		
OF002-970422-01	**0.64**	-0.45	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.74**	-0.30		
OF002-970430-01	**0.54**	-0.62	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.64**	-0.45		

TABLE 5.25
CONCENTRATIONS OF PCBs IN SURFACE WATER - RECREATIONAL RECEPTOR EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-970506-01	**0.93**	-0.07	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.03**	0.03		
OF002-970520-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-970603-01	**0.53**	-0.63	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.63**	-0.46		
OF002-970624-01	**0.69**	-0.37	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.79**	-0.24		
OF002-970708-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-970723-01	**0.83**	-0.19	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.93**	-0.07		
OF002-970805-01	**0.36**	-1.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.46**	-0.78		
OF002-970826-01	**0.59**	-0.53	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.69**	-0.37		
OF002-970903-01	**0.67**	-0.40	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.77**	-0.26		
OF002-970926-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-971007-01	**0.88**	-0.13	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.98**	-0.02		
OF002-971028-01	**0.73**	-0.31	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.83**	-0.19		
OF002-971104-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-971118-01	**0.33**	-1.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.43**	-0.84		
OF002-971128-01	**0.16**	-1.83	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.26**	-1.35		
OF002-971128-02	**0.18**	-1.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.28**	-1.27		
OF002-971209-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-971216-01	**0.33**	-1.11	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.43**	-0.84		
OF002-980106-01	**0.52**	-0.65	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.62**	-0.48		
OF002-980120-01	**0.55**	-0.60	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.65**	-0.43		
OF002-980203-01	**0.72**	-0.33	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.82**	-0.20		
OF002-980217-01	**0.27**	-1.31	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.37**	-0.99		
OF002-980303-01	**0.47**	-0.76	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.57**	-0.56		
OF002-980324-01	**0.96**	-0.04	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.06**	0.06		
OF002-980407-01	**0.8**	-0.22	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.90**	-0.11		
OF002-980421-01	**0.72**	-0.33	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.82**	-0.20		
OF002-980505-01	**0.82**	-0.20	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.92**	-0.08		
OF002-980519-01	**0.77**	-0.26	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.87**	-0.14		
OF002-980602-01	**0.78**	-0.25	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.88**	-0.13		
OF002-980616-01	**0.49**	-0.71	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.59**	-0.53		
OF002-980707-01	**0.62**	-0.48	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.72**	-0.33		
OF002-980721-01	**0.57**	-0.56	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.67**	-0.40		
OF002-980804-01	**0.78**	-0.25	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.88**	-0.13		
OF002-980818-01	**0.98**	-0.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.08**	0.08		
OF002-980826-02	**0.96**	-0.04	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.06**	0.06		
OF002-980827-01	**0.35**	-1.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.45**	-0.80		
OF002-980909-01	**0.84**	-0.17	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.94**	-0.06		

TABLE 5.25
CONCENTRATIONS OF PCBs IN SURFACE WATER - RECREATIONAL RECEPTOR EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-980929-01	**0.36**	-1.02	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.46**	-0.78		
OF002-981008-01	**0.65**	-0.43	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.75**	-0.29		
OF002-981020-01	**0.8**	-0.22	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.90**	-0.11		
OF002-981113-01	**0.7**	-0.36	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.80**	-0.22		
OF002-981117-01	**0.65**	-0.43	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.75**	-0.29		
OF002-981211-01	**0.68**	-0.39	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.78**	-0.25		
OF002-990108-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-990112-01	**1.2**	0.18	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.30**	0.26		
OF002-990119-01	**1**	0.00	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.10**	0.10		
OF002-990122-01	**0.28**	-1.27	0.10	J	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-990123-01	**0.66**	-0.42	0.10	J	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.76**	-0.27		
OF002-990124-01	**0.65**	-0.43	0.10	J	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.75**	-0.29		
OF002-990202-01	**0.62**	-0.48	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.72**	-0.33		
OF002-990216-01	**0.95**	-0.05	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**1.05**	0.05		
OF002-990302-01	**0.87**	-0.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.97**	-0.03		
OF002-990316-01	**0.45**	-0.80	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.55**	-0.60		
OF002-990407-01	**0.58**	-0.54	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.68**	-0.39		
OF002-990420-01	**0.42**	-0.87	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.52**	-0.65		
OF002-990511-01	**0.45**	-0.80	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.55**	-0.60		
OF002-990525-01	**0.37**	-0.99	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.47**	-0.76		
OF002-990608-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-990622-01	**0.38**	-0.97	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.48**	-0.73		
OF002-990707-01	**0.62**	-0.48	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.72**	-0.33		
OF002-990720-01	**0.23**	-1.47	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.33**	-1.11		
OF002-990722-01	**0.29**	-1.24	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.39**	-0.94		
OF002-990803-01	**0.44**	-0.82	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.54**	-0.62		
OF002-990805-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-990818-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-990820-01	**0.17**	-1.77	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.27**	-1.31		
OF002-990825-01	**0.2**	-1.61	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.30**	-1.20		
OF002-990908-01	**0.5**	-0.69	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.60**	-0.51		
OF002-990930-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.42**	-0.87		
OF002-991005-01	**0.32**	-1.14	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.42**	-0.87		
OF002-991012-01	**0.28**	-1.27	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.38**	-0.97		
OF002-991012-02	**0.3**	-1.20	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.40**	-0.92		
OF002-991019-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-991026-02	**0.23**	-1.47	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.33**	-1.11		

TABLE 5.25
CONCENTRATIONS OF PCBs IN SURFACE WATER - RECREATIONAL RECEPTOR EXPOSURE

	Aroclor - 1242 (ug/L)				Aroclor - 1248 (ug/L)				Aroclor - 1260 (ug/L)				Total PCBs (ug/L)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
OF002-991103-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991110-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991117-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991124-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991125-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991201-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991208-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
OF002-991215-01	**0.22**	-1.51	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.32**	-1.14		
OF002-991222-01	**0.47**	-0.76	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.57**	-0.56		
OF002-991229-01	**0.12**	-2.12	0.10		0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	**0.22**	-1.51		
SWBRU-980602-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
SWICBR-980602-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
SWICDB-980602-01	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.05	-3.00	0.10	U	0.15	-1.90		
Number	159				160				160				160			
Minimum Detection	0.12				7.6				0.14							
Maximum Detection	46				7.6				0.76				7.7			
Average	0.44	-1.18			0.10	-2.97			0.05	-3.00			0.59	-0.77		
Standard Deviation	0.32	1.00			0.60	0.41			0.01	0.11			0.65	0.69		
H Statistic		2.205				1.777				1.670				1.96		
95% UCL		0.603				0.059				0.051				0.653		
RME		0.603				0.059				0.051				0.653		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2.

TABLE 5.26
CONCENTRATIONS OF PCBs IN INDIAN CREEK/BLUE RIVER SUNFISH

	Aroclor - 1248 (mg/kg)				Aroclor - 1254 (mg/kg)				Aroclor - 1260 (mg/kg)				Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual
10260	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10261	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10262	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10263	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	J	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10264	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10265	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10266	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10267	0.005	-5.2983	0.01	U	**0.062**	-2.7806	0.01	J	0.005	-5.2983	0.01	U	**0.062**	-2.7806	0.01	
10440	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.1**	-2.3026	0.01		**0.1**	-2.3026	0.01	
10441	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.047**	-3.0576	0.01	J	**0.047**	-3.0576	0.01	
10442	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.029**	-3.5405	0.01	J	**0.029**	-3.5405	0.01	
10443	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.023**	-3.7723	0.01	J	**0.023**	-3.7723	0.01	
10444	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10445	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10446	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.067**	-2.7031	0.01		**0.067**	-2.7031	0.01	
10447	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
10410	**0.15**	-1.8971	0.01		0.005	-5.2983	0.01	U	**0.028**	-3.5756	0.01	J	**0.178**	-1.7260	0.01	
10411	**1.4**	0.3365	0.01		0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**1.4**	0.3365	0.01	
10412	**0.045**	-3.1011	0.01	J	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.045**	-3.1011	0.01	
10413	**0.043**	-3.1466	0.01	J	0.005	-5.2983	0.01	U	**0.025**	-3.6889	0.01	J	**0.068**	-2.6882	0.01	
10414	**0.068**	-2.6882	0.01		0.005	-5.2983	0.01	U	**0.031**	-3.4738	0.01	J	**0.099**	-2.3126	0.01	
10415	**0.13**	-2.0402	0.01		0.005	-5.2983	0.01	U	**0.033**	-3.4112	0.01	J	**0.163**	-1.8140	0.01	
10416	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.082**	-2.5010	0.01	J	**0.082**	-2.5010	0.01	
10417	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.045**	-3.1011	0.01		**0.045**	-3.1011	0.01	
3730													**0.027**	-3.6119	0.01	
3731													**0.0136**	-4.2977	0.01	
3732													**0.0473**	-3.0512	0.01	
3733													**0.0148**	-4.2131	0.01	
3734													**0.0128**	-4.3583	0.01	
3735													**0.0102**	-4.5854	0.01	
3736													**0.0143**	-4.2475	0.01	
3737													**0.0107**	-4.5375	0.01	
3780													**0.1342**	-2.0084	0.01	
3781													**0.1532**	-1.8760	0.01	
3782													**0.0935**	-2.3698	0.01	
3783													**0.16**	-1.8326	0.01	
3784													**0.153**	-1.8773	0.01	
3785													**0.0556**	-2.8896	0.01	
3786													**0.0665**	-2.7106	0.01	
3787													**0.1413**	-1.9569	0.01	
3818													**0.1**	-2.3026	0.01	
3819													**0.245**	-1.4065	0.01	
3829													**0.1443**	-1.9359	0.01	
3776													**0.162**	-1.8202	0.01	
3777													**0.076**	-2.5770	0.01	
3778													**0.172**	-1.7603	0.01	
3779													**0.0785**	-2.5447	0.01	
3739													**0.183**	-1.6983	0.01	
3890													**0.296**	-1.2174	0.01	
3891													**0.453**	-0.7919	0.01	
3892													**0.139**	-1.9733	0.01	
3893													**0.714**	-0.3369	0.01	

TABLE 5.26
CONCENTRATIONS OF PCBs IN INDIAN CREEK/BLUE RIVER SUNFISH

	Aroclor - 1248 (mg/kg)				Aroclor - 1254 (mg/kg)				Aroclor - 1260 (mg/kg)				Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual
3894													0.118	-2.1371	0.01	
3895													0.116	-2.1542	0.01	
3896													1.433	0.3598	0.01	
3897													0.174	-1.7487	0.01	
3754													0.043	-3.1466	0.01	
3755													0.018	-4.0174	0.01	
3756													0.022	-3.8167	0.01	
3757													0.0204	-3.8922	0.01	
3758													0.064	-2.7489	0.01	
3759													0.179	-1.7204	0.01	
3766													0.015	-4.1997	0.01	
3767													0.026	-3.6497	0.01	
3800													0.155	-1.8643	0.01	
3801													0.052	-2.9565	0.01	
3802													0.0436	-3.1327	0.01	
3803													0.102	-2.2828	0.01	
3804													0.0403	-3.2114	0.01	
3805													0.0396	-3.2289	0.01	
3806													0.0337	-3.3903	0.01	
3807													0.11	-2.2073	0.01	
3810													0.188	-1.6713	0.01	
3811													0.07	-2.6593	0.01	
3812													0.0748	-2.5929	0.01	
3813													0.543	-0.6106	0.01	
3814													0.096	-2.3434	0.01	
3815													0.249	-1.3903	0.01	
3816													0.164	-1.8079	0.01	
3817													0.076	-2.5770	0.01	
5900	0.01	-4.6052	0.01		0.05	-2.9957	0.01		0.02	-3.9120	0.01		0.08	-2.5257	0.01	
5901	0.005	-5.2983	0.01	U	0.01	-4.6052	0.01		0.005	-5.2983	0.01	U	0.01	-4.6052	0.01	
5902	0.01	-4.6052	0.01		0.2	-1.6094	0.01		0.005	-5.2983	0.01	U	0.21	-1.5606	0.01	
5903	0.13	-2.0402	0.01		0.19	-1.6607	0.01		0.005	-5.2983	0.01	U	0.32	-1.1394	0.01	
5904	0.005	-5.2983	0.01	U	0.04	-3.2189	0.01		0.005	-5.2983	0.01	U	0.04	-3.2189	0.01	
5905	0.005	-5.2983	0.01	U	0.09	-2.4079	0.01		0.03	-3.5066	0.01		0.12	-2.1203	0.01	
5906	0.01	-4.6052	0.01		0.005	-5.2983	0.01	U	0.02	-3.9120	0.01		0.03	-3.5066	0.01	
5907	0.005	-5.2983	0.01	U	0.01	-4.6052	0.01		0.03	-3.5066	0.01		0.04	-3.2189	0.01	
5690	0.02	-3.9120	0.01		0.37	-0.9943	0.01		0.07	-2.6593	0.01		0.46	-0.7765	0.01	
5691	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
5692	0.005	-5.2983	0.01	U	0.04	-3.2189	0.01		0.02	-3.9120	0.01		0.06	-2.8134	0.01	
5693	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.01	-4.6052	0.01		0.01	-4.6052	0.01	
5694	0.02	-3.9120	0.01		0.15	-1.8971	0.01		0.16	-1.8326	0.01		0.33	-1.1087	0.01	
5695	0.005	-5.2983	0.01	U	0.07	-2.6593	0.01		0.04	-3.2189	0.01		0.11	-2.2073	0.01	
5696	0.005	-5.2983	0.01	U	0.08	-2.5257	0.01		0.04	-3.2189	0.01		0.12	-2.1203	0.01	
5697	0.005	-5.2983	0.01	U	0.03	-3.5066	0.01		0.005	-5.2983	0.01	U	0.03	-3.5066	0.01	
5660	0.03	-3.5066	0.01		0.09	-2.4079	0.01		0.03	-3.5066	0.01		0.15	-1.8971	0.01	
5661	0.03	-3.5066	0.01		0.01	-4.6052	0.01		0.02	-3.9120	0.01		0.06	-2.8134	0.01	
5662	0.005	-5.2983	0.01	U	0.12	-2.1203	0.01		0.05	-2.9957	0.01		0.17	-1.7720	0.01	
5663	0.09	-2.4079	0.01		0.04	-3.2189	0.01		0.02	-3.9120	0.01		0.15	-1.8971	0.01	
5664	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
5665	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
5666	0.03	-3.5066	0.01		0.09	-2.4079	0.01		0.03	-3.5066	0.01		0.15	-1.8971	0.01	
5667	0.03	-3.5066	0.01		0.03	-3.5066	0.01		0.01	-4.6052	0.01		0.07	-2.6593	0.01	

TABLE 5.26
CONCENTRATIONS OF PCBs IN INDIAN CREEK/BLUE RIVER SUNFISH

	Aroclor - 1248 (mg/kg)				Aroclor - 1254 (mg/kg)				Aroclor - 1260 (mg/kg)				Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual
5670	0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01		0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01	
5671	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.01**	-4.6052	0.01		**0.03**	-3.5066	0.01	
5672	0.005	-5.2983	0.01	U	**0.03**	-3.5066	0.01		0.005	-5.2983	0.01	U	**0.03**	-3.5066	0.01	
5673	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
5674	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.02**	-3.9120	0.01	
5675	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
5676	**0.02**	-3.9120	0.01		**0.05**	-2.9957	0.01		0.005	-5.2983	0.01	U	**0.07**	-2.6593	0.01	
5677	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01	
5390	**0.01**	-4.6052	0.01		**0.05**	-2.9957	0.01		0.005	-5.2983	0.01	U	**0.06**	-2.8134	0.01	
5391	**0.08**	-2.5257	0.01		**0.14**	-1.9661	0.01		**0.04**	-3.2189	0.01		**0.26**	-1.3471	0.01	
5392	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.01**	-4.6052	0.01		**0.03**	-3.5066	0.01	
5393	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.01**	-4.6052	0.01		**0.03**	-3.5066	0.01	
5394	**0.01**	-4.6052	0.01		**0.07**	-2.6593	0.01		**0.02**	-3.9120	0.01		**0.1**	-2.3026	0.01	
5395	0.005	-5.2983	0.01	U	**0.18**	-1.7148	0.01		**0.01**	-4.6052	0.01		**0.18**	-1.7148	0.01	
5396	**0.2**	-1.6094	0.01		**0.26**	-1.3471	0.01		**0.03**	-3.5066	0.01		**0.49**	-0.7133	0.01	
5397	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.01**	-4.6052	0.01		**0.03**	-3.5066	0.01	
5680	0.005	-5.2983	0.01	U	**0.05**	-2.9957	0.01		**0.01**	-4.6052	0.01		**0.06**	-2.8134	0.01	
5681	0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01		**0.01**	-4.6052	0.01		**0.02**	-3.9120	0.01	
5682	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U	0.005	-5.2983	0.01	U
5683	**0.03**	-3.5066	0.01		**0.06**	-2.8134	0.01		**0.01**	-4.6052	0.01		**0.1**	-2.3026	0.01	
5684	0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01		0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01	
5685	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.01**	-4.6052	0.01		**0.03**	-3.5066	0.01	
5686	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		**0.01**	-4.6052	0.01		**0.03**	-3.5066	0.01	
5687	0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01		0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01	
5920	0.005	-5.2983	0.01	U	**0.03**	-3.5066	0.01		0.005	-5.2983	0.01	U	**0.03**	-3.5066	0.01	
5921	0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01		0.005	-5.2983	0.01	U	**0.01**	-4.6052	0.01	
5922	**0.05**	-2.9957	0.01		**0.08**	-2.5257	0.01		0.005	-5.2983	0.01	U	**0.13**	-2.0402	0.01	
5923	**0.55**	-0.5978	0.01		**0.65**	-0.4308	0.01		0.005	-5.2983	0.01	U	**1.2**	0.1823	0.01	
5924	**0.04**	-3.2189	0.01		**0.2**	-1.6094	0.01		0.005	-5.2983	0.01	U	**0.24**	-1.4271	0.01	
5925	0.005	-5.2983	0.01	U	**0.03**	-3.5066	0.01		0.005	-5.2983	0.01	U	**0.03**	-3.5066	0.01	
5628	0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01		0.005	-5.2983	0.01	U	**0.02**	-3.9120	0.01	
5629	0.005	-5.2983	0.01	U	**0.1**	-2.3026	0.01		0.005	-5.2983	0.01	U	**0.1**	-2.3026	0.01	
4810													**0.16**	-1.8452	0.01	
4811													**0.25**	-1.3783	0.01	
4812													**0.24**	-1.4271	0.01	
4813													**0.12**	-2.1286	0.01	
4948													**0.10**	-2.2828	0.01	
4669													**0.57**	-0.5586	0.01	
4690													**0.08**	-2.5396	0.01	
4691													**0.22**	-1.5096	0.01	
4692													**0.13**	-2.0250	0.01	
4693													**0.31**	-1.1809	0.01	
4695													**0.12**	-2.1628	0.01	
4696													**0.28**	-1.2801	0.01	
4697													**0.18**	-1.7430	0.01	
7964													**0.18**	-1.7373	0.01	
4652													**0.01**	-4.3051	0.01	
4653													**0.02**	-3.9021	0.01	
4654													**0.01**	-5.2983	0.01	
4655													**0.02**	-4.0923	0.01	
4656													**0.03**	-3.4112	0.01	
4657													**0.05**	-2.9957	0.01	

TABLE 5.26
CONCENTRATIONS OF PCBs IN INDIAN CREEK/BLUE RIVER SUNFISH

	Aroclor - 1248 (mg/kg)				Aroclor - 1254 (mg/kg)				Aroclor - 1260 (mg/kg)				Total PCBs (mg/kg)			
Sample ID	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual	Result	Log Result	RL	Qual
4658													**0.14**	-1.9379	0.01	
4659													**0.02**	-4.1997	0.01	
8564													**0.11**	-2.2443	0.01	
884													**0.09**	-2.3752	0.01	
4880													**0.09**	-2.3752	0.01	
4881													**0.06**	-2.9004	0.01	
4882													**0.06**	-2.8647	0.01	
4883													**0.21**	-1.5702	0.01	
4884													**0.11**	-2.1982	0.01	
4885													**0.64**	-0.4526	0.01	
4886													**0.09**	-2.4534	0.01	
4887													**2.93**	1.0750	0.01	
4890													**0.14**	-1.9590	0.01	
4891													**0.24**	-1.4313	0.01	
4892													**0.07**	-2.6451	0.01	
4893													**0.05**	-3.0576	0.01	
4894													**0.06**	-2.8473	0.01	
4895													**0.04**	-3.3524	0.01	
4896													**0.12**	-2.1120	0.01	
4897													**0.13**	-2.0326	0.01	
5984													**0.06**	-2.8473	0.01	
664													**0.25**	-1.3943	0.01	
4660													**0.04**	-3.2442	0.01	
4661													**0.16**	-1.8202	0.01	
4662													**0.05**	-2.9759	0.01	
4663													**0.03**	-3.4420	0.01	
4664													**0.02**	-3.8632	0.01	
4665													**0.02**	-3.9633	0.01	
4666													**0.05**	-2.9957	0.01	
4667													**0.02**	-4.0923	0.01	
Number	80				80				80				186			
Minimum Detection	0.01				0.01				0.01				0.002			
Maximum Detection	1.4				0.65				0.16				2.93			
Average	0.04	-4.58			0.05	-3.97			0.02	-4.49			0.14	-2.82		
Standard Deviation	0.17	1.26			0.10	1.37			0.02	0.95			0.28	1.31		
H Statistic		2.447				2.577				2.151				2.447		
95% UCL		0.032				0.072				0.022				0.178		
RME		0.032				0.072				0.022				0.178		

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected
J = Estimated value below reporting limit or estimated based on data quality review
U = Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result; used to calculate the 95% UCL of the mean
95% UCL = 95 percent Upper Confidence Limit. See Section V.C.1.3.2

TABLE 5.27
CONCENTRATIONS OF PCBs IN INDIAN CREEK/BLUE RIVER CHANNEL CATFISH

	Aroclor - 1248 (mg/kg)				Aroclor - 1254 (mg/kg)				Aroclor - 1260 (mg/kg)				Total PCBs (mg/kg)		
Sample ID	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL	Qual.	Result	Log Result	RL
3760													**0.0894**	-2.4146	0.01
3761													**0.132**	-2.0250	0 01
3762													**0.153**	-1 8773	0.01
3763													**0.0802**	-2 5232	0.01
3764													**0.0755**	-2.5836	0.01
3765													**0.4687**	-0.7578	0 01
3770													**1.599**	0.4694	0 01
3771													**0.848**	-0.1649	0 01
3772													**0.3597**	-1.0225	0.01
3773													**1.123**	0.1160	0.01
3774													**0.1027**	-2.2759	0.01
3775													**0.622**	-0.4748	0 01
5650	**0.28**	-1.2730	0.01		**1.01**	0.0100	0.01		**0.03**	-3.5066	0.01		**1.32**	0.2776	0.01
5651	0.005	-5.2983	0.01	U	**0.4**	-0.9163	0.01		0.005	-5.2983	0.01	U	**0.4**	-0.9163	0.01
5652	0.005	-5 2983	0.01	U	**0.27**	-1.3093	0.01		**0.01**	-4.6052	0.01		**0.28**	-1.2730	0.01
5653	**0.04**	-3.2189	0.01		**0.68**	-0.3857	0.01		0.005	-5.2983	0.01	U	**0.72**	-0.3285	0.01
5654	**0.04**	-3.2189	0.01		**1.4**	0.3365	0.01		0.005	-5.2983	0.01	U	**1.44**	0.3646	0.01
5655	0.005	-5.2983	0.01	U	**0.52**	-0.6539	0.01		0.005	-5 2983	0.01	U	**0.52**	-0.6539	0.01
5698	**0.17**	-1.7720	0.01		**0.78**	-0.2485	0.01		0.005	-5.2983	0.01	U	**0.95**	-0.0513	0 01
5699	**0.11**	-2.2073	0 01		**0.72**	-0.3285	0.01		**0.02**	-3.9120	0 01		**0.85**	-0.1625	0 01
5398	**0.19**	-1.6607	0.01		**0.69**	-0.3711	0.01		**0.22**	-1.5141	0.01		**1.1**	0.0953	0 01
5399	**0.15**	-1 8971	0 01		**0.9**	-0.1054	0.01		0.005	-5.2983	0.01	U	**1.05**	0.0488	0 01
5688	**0.13**	-2 0402	0 01		**0.77**	-0.2614	0.01		0.005	-5.2983	0.01	U	**0.9**	-0.1054	0 01
5689	**0.16**	-1.8326	0.01		**0.43**	-0 8440	0.01		**0.05**	-2.9957	0.01		**0.64**	-0 4463	0 01
4672													**0.065**	-2.7272	0 01
4673													**0.071**	-2.6507	0 01
4674													**0.077**	-2.5652	0 01
4675													**0.570**	-0.5628	0 01
4676													**0.067**	-2.7091	0.01
4818													**0.398**	-0.9213	0 01
4819													**0.087**	-2.4453	0.01
4898													**0.257**	-1.3587	0.01
Number	12				12				12				32		
Minimum Detection	0 04				0 27				0 01				0 065		
Maximum Detection	0 28				1.4				0.22				1 60		
Average	0.11	-2 92			0 71	-0.42			0.03	-4.47			0 54	-1.08	
Standard Deviation	0 09	1.55			0.30	0.45			0 06	1.24			0 46	1 08	
H Statistic		3 896				2 082				3.389				2 558	
95% UCL		1.096				0 958				0.088				1 005	
RME		0.280				0 958				0 088				1 005	

RL = Laboratory reporting limit
RME = Lower of 95% UCL or maximum detected concentration
J - Estimated value below reporting limit or estimated based on data quality review
U - Analyte not detected. Value shown is one-half the reporting limit.
Bold = Analyte detected in sample
Log result is the natural logarithm of the result, used to calculate the 95% UCL of the mean.
95% UCL = 95 percent Upper Confidence Limit See Section V C 1.3.2.

TABLE 5.28
SUMMARY OF INTAKE FACTORS[1] FOR RECEPTORS

Excavation Worker	Central Tendency	RME
Deep Soil Ingestion (kg/kg-d)		
Noncarcinogenic	2.49E-07	9.95E-07
Carcinogenic	1.91E-10	1.53E-09
Dermal Contact with Deep Soil (kg/kg-d)		
Noncarcinogenic	4.40E-07	7.28E-06
Carcinogenic	3.38E-10	1.12E-08
Utility Worker		
Shallow Soil Ingestion (kg/kg-d)		
Noncarcinogenic	2.49E-07	9.95E-07
Carcinogenic	1.91E-10	1.53E-09
Dermal Contact with Shallow Soil (kg/kg-d)		
Noncarcinogenic	4.40E-07	7.28E-06
Carcinogenic	3.38E-10	1.12E-08
Construction Worker		
Surface Water Ingestion (L/kg-d)		
Noncarcinogenic	4.97E-05	9.95E-05
Carcinogenic	3.28E-08	1.53E-07
Dermal Contact with Surface Water (L/kg-d)		
Noncarcinogenic	9.68E-02	1.60E-01
Carcinogenic	7.43E-05	2.46E-04
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	2.49E-07	9.95E-07
Carcinogenic	1.91E-10	1.53E-09
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	4.40E-07	7.28E-06
Carcinogenic	3.38E-10	1.12E-08

TABLE 5.28
SUMMARY OF INTAKE FACTORS[1] FOR RECEPTORS

Adult Recreation Receptor	Central Tendency	RME
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	2.48E-08	1.98E-07
Carcinogenic	2.98E-09	7.94E-08
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	5.63E-08	2.16E-06
Carcinogenic	6.75E-09	8.64E-07
Fish Ingestion (kg/kg-d)		
Noncarcinogenic	1.11E-05	7.87E-05
Carcinogenic	1.34E-06	3.15E-05
Surface Water Ingestion (L/kg-d)		
Noncarcinogenic	4.96E-06	1.98E-05
Carcinogenic	5.95E-07	7.94E-06
Dermal Contact with Surface Water (L/kg-d)		
Noncarcinogenic	6.19E-03	4.75E-02
Carcinogenic	7.43E-04	1.90E-02

Child Recreation Receptor	Central Tendency	RME
Fish Ingestion (kg/kg-d)		
Noncarcinogenic	8.83E-06	6.35E-05
Carcinogenic	1.06E-06	7.62E-06
Sediment Ingestion (kg/kg-d)		
Noncarcinogenic	7.86E-08	6.29E-07
Carcinogenic	9.43E-09	7.55E-08
Dermal Contact with Sediment (kg/kg-d)		
Noncarcinogenic	8.92E-08	3.43E-06
Carcinogenic	1.07E-08	4.11E-07
Surface Water Ingestion (L/kg-d)		
Noncarcinogenic	7.86E-06	3.14E-05
Carcinogenic	9.43E-07	3.77E-06
Dermal Contact with Surface Water (L/kg-d)		
Noncarcinogenic	9.81E-03	7.54E-02
Carcinogenic	1.18E-03	9.04E-03

[1] Exposure assumptions and intake factor calculations are shown in Tables 5.1 through 5.16.
Intake factors are multiplied by exposure point concentrations of chemicals of potential concern to estimate daily chemical intake in terms of mg chemical per kilogram weight per day (mg/kg-d).

TABLE 5.29
REFERENCE DOSES FOR NONCARCINOGENIC PCBs OF POTENTIAL CONCERN

Chemical	Noncarcinogenic RfD (mg/kg/d)				Uncertainty Factor		Confidence Level	Critical Effect	Species/Experiment Length/ Target Organ
	Inhalation	Source	Oral	Source	Inhal	Oral			
Aroclor-1254								Reduced birth weights, immune system breakdown	Monkey, 0.007-0.028 mg/kg-day, 654 days
Subchronic			5×10^{-5}	2					
Chronic	ND	NA	2×10^{-5}	1	NA	300			
Aroclor 1242									
Subchronic			5×10^{-5}	3					
Chronic	ND	NA	2×10^{-5}	3					
Aroclor 1248									
Subchronic			5×10^{-5}	3					
Chronic	ND	NA	2×10^{-5}	3					
Aroclor 1260									
Subchronic			5×10^{-5}	3					
Chronic	ND	NA	2×10^{-5}	3					

ND = No data
NA = Not applicable/Not available

1 Verifiable in IRIS
2 HEAST 1997
3 Aroclor 1254 was used as a surrogate compound for evaluating adverse health effects.

TABLE 5.30

SLOPE FACTOR FOR CARCINOGENIC PCBs OF POTENTIAL CONCERN

Chemical	Carcinogenic Slope Factor (mg/kg/d)$^{-1}$				EPA Class	Critical Effect	Species/Experiment Length/Target Organ
	Inhalation	Source	Oral	Source			
Aroclor 1242	NA		NA	1			
Aroclor 1248	NA		NA	1			
Aroclor 1254	NA		NA	1			
Aroclor 1260	NA		NA	1			
Total PCBs	NA		2E+00	1	B2	Hepatocellular carcinoma	Rats, 100 ppm, oral, 630 days; liver

ND = No data
e = ECAO
p = provisional value (EPA-NCEA)

1 Verifiable in IRIS
2 HEAST 1997
3 Carcinogenic PAH toxicity based on benzo(a)pyrene (EPA Region IV)

TABLE 5.31
EXCAVATION WORKER HEALTH RISK: INCIDENTAL INGESTION OF DEEP SOILS

	Deep Soil Concentration	Noncarcinogenic IF		Carcinogenic IF		Subchronic		Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	5.20E-01	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		2.59E-03	1.03E-02		
Aroclor 1248	3.90E-02	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		1.94E-04	7.76E-04		
Aroclor 1260	7.40E-02	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		3.68E-04	1.47E-03		
Total PCBs	1.30E+01	2.49E-07	9.95E-07	1.91E-10	1.53E-09		2.00E+00			4.96E-09	3.97E-08
							Totals	**0.003**	**0.01**	**5E-09**	**4E-08**

RME deep soil concentrations from Table 5.17
RME = Reasonable Maximum Exposure

IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.32
EXCAVATION WORKER HEALTH RISK: DERMAL CONTACT WITH DEEP SOILS

	Deep Soil	Noncarcinogenic IF		Carcinogenic IF		Subchronic	Slope	Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	5.20E-01	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		4.58E-03	7.58E-02		
Aroclor 1248	3.90E-02	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		3.43E-04	5.68E-03		
Aroclor 1260	7.40E-02	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		6.51E-04	1.08E-02		
Total PCBs	1.30E+01	4.40E-07	7.28E-06	3.38E-10	1.12E-08		2.00E+00			8.78E-09	2.91E-07
							Totals	**0.006**	**0.09**	**9E-09**	**3E-07**

RME deep soil concentrations from Table 5.17.
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.33
SUMMARY OF HEALTH RISKS FOR EXCAVATION WORKER EXPOSURE TO DEEP SOIL

Receptor/Pathway	Average Exposure		Reasonable Maximum Exposure	
	Subchronic H.I.	Cancer Risk	Subchronic H.I.	Cancer Risk
Excavation Worker				
Ingestion of Deep Soil	0.003	5E-09	0.01	4E-08
Dermal Contact with Deep Soil	0.006	9E-09	0.09	3E-07
	0.01	**1E-08**	**0.10**	**3E-07**

Risk values from Tables 5.31 and 5.32.

Discrepancies in numbers are due to rounding.

TABLE 5.34
UTILITY WORKER HEALTH RISK: INCIDENTAL INGESTION OF SHALLOW SOILS

	Deep Soil Concentration RME (mg/kg)	Noncarcinogenic IF Average (kg/kg-day)	Noncarcinogenic IF RME (kg/kg-day)	Carcinogenic IF Average (kg/kg-day)	Carcinogenic IF RME (kg/kg-day)	Subchronic RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Hazard Quotient Average	Hazard Quotient RME	Cancer Risk Average	Cancer Risk RME
PCBs											
Aroclor 1242	1.07E+00	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		5.32E-03	2.13E-02		
Aroclor 1248	8.70E-01	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		4.33E-03	1.73E-02		
Aroclor 1260	6.30E-02	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		3.13E-04	1.25E-03		
Total PCBs	2.12E+00	2.49E-07	9.95E-07	1.91E-10	1.53E-09		2.00E+00			8.09E-10	6.47E-09
							Totals	**0.010**	**0.04**	**8E-10**	**6E-09**

RME shallow soil concentrations from Table 5.17
RME = Reasonable Maximum Exposure

IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.35
UTILITY WORKER HEALTH RISK: DERMAL CONTACT WITH SHALLOW SOILS

	Deep Soil	Noncarcinogenic IF		Carcinogenic IF		Subchronic	Slope	Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	1.07E+00	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		9.42E-03	1.56E-01		
Aroclor 1248	8.70E-01	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		7.66E-03	1.27E-01		
Aroclor 1260	6.30E-02	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		5.55E-04	9.18E-03		
Total PCBs	2.12E+00	4.40E-07	7.28E-06	3.38E-10	1.12E-08		2.00E+00			1.43E-09	4.74E-08
							Totals	**0.018**	**0.29**	**1E-09**	**5E-08**

RME shallow soil concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.36
SUMMARY OF HEALTH RISKS FOR UTILITY WORKER EXPOSURE TO SHALLOW SOIL

Receptor/Pathway	Average Exposure		Reasonable Maximum Exposure	
	Subchronic H.I.	Cancer Risk	Subchronic H.I.	Cancer Risk
Utility Worker				
Ingestion of Shallow Soil	0.010	8E-10	0.04	6E-09
Dermal Contact with Shallow Soil	0.018	1E-09	0.29	5E-08
	0.03	**2E-09**	**0.33**	**5E-08**

Risk values from Tables 5.34 and 5.35.

Discrepancies in numbers are due to rounding.

TABLE 5.37
CONSTRUCTION WORKER HEALTH RISK: INCIDENTAL INGESTION OF SEDIMENTS

	Sediment Concentrations	Noncarcinogenic IF		Carcinogenic IF		Subchronic		Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	3.71E+02	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		1.85E+00	7.38E+00		
Aroclor 1248	2.98E+00	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		1.48E-02	5.93E-02		
Aroclor 1260	3.25E+00	2.49E-07	9.95E-07	1.91E-10	1.53E-09	5.00E-05		1.62E-02	6.47E-02		
Total PCBs	3.54E+02	2.49E-07	9.95E-07	1.91E-10	1.53E-09		2.00E+00			1.35E-07	1.08E-06
							Totals	**1.88**	**7.5**	**1E-07**	**1E-06**

RME sediment concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.38
CONSTRUCTION WORKER HEALTH RISK: DERMAL CONTACT WITH SEDIMENTS

	Sediment Concentration	Noncarcinogenic IF		Carcinogenic IF		Subchronic	Slope	Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	3.71E+02	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		3.27E+00	5.40E+01		
Aroclor 1248	2.98E+00	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		2.62E-02	4.34E-01		
Aroclor 1260	3.25E+00	4.40E-07	7.28E-06	3.38E-10	1.12E-08	5.00E-05		2.86E-02	4.73E-01		
Total PCBs	3.54E+02	4.40E-07	7.28E-06	3.38E-10	1.12E-08		2.00E+00			2.39E-07	7.91E-06
							Totals	**3.32**	**55.0**	**2E-07**	**8E-06**

RME sediment concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.39
CONSTRUCTION WORKER HEALTH RISK: INCIDENTAL INGESTION OF SURFACE WATER

	Surface Water	Noncarcinogenic IF		Carcinogenic IF		Subchronic		Hazard Quotient		Cancer Risk	
	RME	Average	RME	Average	RME	RfD	Slope Factor	Average	RME	Average	RME
	(mg/L)	(L/kg-day)	(L/kg-day)	(L/kg-day)	(L/kg-day)	(mg/kg-day)	$(mg/kg\text{-}day)^{-1}$				
PCBs											
Aroclor 1242	8.75E-04	4.97E-05	9.95E-05	3.82E-08	1.53E-07	5.00E-05		8.70E-04	1.74E-03		
Aroclor 1248	5.80E-05	4.97E-05	9.95E-05	3.82E-08	1.53E-07	5.00E-05		5.77E-05	1.15E-04		
Aroclor 1260	5.40E-05	4.97E-05	9.95E-05	3.82E-08	1.53E-07	5.00E-05		5.37E-05	1.07E-04		
Total PCBs	8.98E-04	4.97E-05	9.95E-05	3.82E-08	1.53E-07		2.00E+00			6.85E-11	2.74E-10
							Totals	**0.001**	**0.002**	**7E-11**	**3E-10**

RME surface water concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.40
CONSTRUCTION WORKER HEALTH RISK: DERMAL CONTACT WITH SURFACE WATER

	Surface Water RME (mg/L)	Noncarcinogenic IF Average (L/kg-day)	Noncarcinogenic IF RME (L/kg-day)	Carcinogenic IF Average (L/kg-day)	Carcinogenic IF RME (L/kg-day)	Subchronic RfD (mg/kg-d)	Slope Factor $(mg/kg\text{-}d)^{-1}$	Hazard Quotient Average	Hazard Quotient RME	Cancer Risk Average	Cancer Risk RME
PCBs											
Aroclor 1242	8.75E-04	9.68E-02	1.60E-01	7.43E-05	2.46E-04	5.00E-05		1.69E+00	2.80E+00		
Aroclor 1248	5.80E-05	9.68E-02	1.60E-01	7.43E-05	2.46E-04	5.00E-05		1.12E-01	1.86E-01		
Aroclor 1260	5.40E-05	9.68E-02	1.60E-01	7.43E-05	2.46E-04	5.00E-05		1.05E-01	1.73E-01		
Total PCBs	8.98E-04	9.68E-02	1.60E-01	7.43E-05	2.46E-04		2.00E+00			1.33E-07	4.42E-07
							Totals	**1.91**	**3.16**	**1E-07**	**4E-07**

RME Surface Water concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = Adjusted RME * Noncarcinogenic IF/RfD
Cancer Risk = Adjusted RME * Carcinogenic IF * Slope Factor

TABLE 5.41
SUMMARY OF HEALTH RISKS FOR CONSTRUCTION WORKER EXPOSURES

Receptor/Pathway	Average Exposure		Reasonable Maximum Exposure	
	Subchronic H.I.	Cancer Risk	Subchronic H.I.	Cancer Risk
Construction Worker				
Incidental Ingestion of Surface Water	0.001	7E-11	0.002	3E-10
Dermal contact with Surface Water	1.91	1E-07	3.16	4E-07
Incidental Ingestion of Sediment	1.88	1E-07	7.5	1E-06
Dermal Contact with Sediment	3.32	2E-07	55.0	8E-06
	7.1	**5E-07**	**66**	**9E-06**

Risk values from Table 5.37 through 5.40.
Discrepancies in numbers are due to rounding.

TABLE 5.42
ADULT RECREATIONAL RECEPTOR HEALTH RISK: INCIDENTAL INGESTION OF SEDIMENT

	Sediment Concentrations	Noncarcinogenic IF		Carcinogenic IF		Chronic		Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	2.30E+00	2.48E-08	1.98E-07	2.98E-09	7.94E-08	2.00E-05		2.85E-03	2.28E-02		
Aroclor 1248	4.00E-01	2.48E-08	1.98E-07	2.98E-09	7.94E-08	2.00E-05		4.96E-04	3.97E-03		
Total PCBs	2.38E+00	2.48E-08	1.98E-07	2.98E-09	7.94E-08		2.00E+00			1.42E-08	3.78E-07
							Totals	**0.003**	**0.03**	**1E-08**	**4E-07**

RME sediment concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.43
ADULT RECREATIONAL RECEPTOR HEALTH RISK: DERMAL CONTACT WITH SEDIMENT

	Sediment Concentrations	Noncarcinogenic IF		Carcinogenic IF		Chronic	Slope	Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-d)	Factor $(mg/kg\text{-}d)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	2.30E+00	5.63E-08	2.16E-06	6.75E-09	8.64E-07	2.00E-05		6.47E-03	2.49E-01		
Aroclor 1248	4.00E-01	5.63E-08	2.16E-06	6.75E-09	8.64E-07	2.00E-05		1.13E-03	4.32E-02		
Total PCBs	2.38E+00	5.63E-08	2.16E-06	6.75E-09	8.64E-07		2.00E+00			3.21E-08	4.11E-06
							Totals	**0.008**	**0.29**	**3E-08**	**4E-06**

RME sediment concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.44
ADULT RECREATIONAL RECEPTOR HEALTH RISK: INCIDENTAL INGESTION OF SURFACE WATER

	Surface Water RME (mg/L)	Noncarcinogenic IF		Carcinogenic IF		Chronic RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Hazard Quotient		Cancer Risk	
		Average (L/kg-day)	RME (L/kg-day)	Average (L/kg-day)	RME (L/kg-day)			Average	RME	Average	RME
PCBs											
Aroclor 1242	6.03E-04	4.96E-06	1.98E-05	5.95E-07	7.94E-06	2.00E-05		1.50E-04	5.98E-04		
Aroclor 1248	5.90E-05	4.96E-06	1.98E-05	5.95E-07	7.94E-06	2.00E-05		1.46E-05	5.85E-05		
Aroclor 1260	5.10E-05	4.96E-06	1.98E-05	5.95E-07	7.94E-06	2.00E-05		1.26E-05	5.06E-05		
Total PCBs	6.53E-04	4.96E-06	1.98E-05	5.95E-07	7.94E-06		2.00E+00			7.77E-10	1.04E-08
							Totals	**0.0002**	**0.001**	**8E-10**	**1E-08**

RME surface water concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.45
ADULT RECREATIONAL RECEPTOR HEALTH RISK: DERMAL CONTACT WITH SURFACE WATER

	Surface Water	Noncarcinogenic IF		Carcinogenic IF		Chronic	Slope	Hazard Quotient		Cancer Risk	
	RME	Average	RME	Average	RME	RfD	Factor	Average	RME	Average	RME
	(mg/L)	(L/kg-day)	(L/kg-day)	(L/kg-day)	(L/kg-day)	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$				
PCBs											
Aroclor 1242	6.03E-04	6.19E-03	4.75E-02	7.43E-04	1.90E-02	2.00E-05		1.87E-01	1.43E+00		
Aroclor 1248	5.90E-05	6.19E-03	4.75E-02	7.43E-04	1.90E-02	2.00E-05		1.83E-02	1.40E-01		
Aroclor 1260	5.10E-05	6.19E-03	4.75E-02	7.43E-04	1.90E-02	2.00E-05		1.58E-02	1.21E-01		
Total PCBs	6.53E-04	6.19E-03	4.75E-02	7.43E-04	1.90E-02		2.00E+00			9.70E-07	2.48E-05
							Totals	**0.2**	**1.70**	**1E-06**	**2E-05**

RME surface water concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = Adjusted RME * Noncarcinogenic IF/RfD
Cancer Risk = Adjusted RME * Carcinogenic IF * Slope Factor

TABLE 5.46
ADULT RECREATIONAL RECEPTOR HEALTH RISK: INGESTION OF CHANNEL CATFISH

	RME Channel Catfish Tissue Concentration (mg/kg)	Noncarcinogenic IF		Carcinogenic IF		Chronic RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Hazard Quotient		Cancer Risk	
		Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)			Average	RME	Average	RME
PCBs											
Aroclor 1248	2.80E-01	1.11E-05	7.87E-05	1.34E-06	3.15E-05	2.00E-05		1.56E-01	1.10E+00		
Aroclor 1254	9.58E-01	1.11E-05	7.87E-05	1.34E-06	3.15E-05	2.00E-05		5.34E-01	3.77E+00		
Aroclor 1260	8.80E-02	1.11E-05	7.87E-05	1.34E-06	3.15E-05	2.00E-05		4.90E-02	3.46E-01		
Total PCBs	1.01E+00	1.11E-05	7.87E-05	1.34E-06	3.15E-05		2.00E+00			2.70E-06	6.36E-05
							Totals	**0.74**	**5.22**	**3E-06**	**6E-05**

RME channel catfish concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.47
ADULT RECREATIONAL RECEPTOR HEALTH RISK: INGESTION OF GREEN SUNFISH

	RME Sunfish Tissue Concentration (mg/kg)	Noncarcinogenic IF		Carcinogenic IF		Chronic RfD (mg/kg-d)	Slope Factor $(mg/kg\text{-}d)^{-1}$	Hazard Quotient		Cancer Risk	
		Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)			Average	RME	Average	RME
PCBs											
Aroclor 1248	3.20E-02	1.11E-05	7.87E-05	1.34E-06	3.15E-05	2.00E-05		1.78E-02	1.26E-01		
Aroclor 1254	7.20E-02	1.11E-05	7.87E-05	1.34E-06	3.15E-05	2.00E-05		4.01E-02	2.83E-01		
Aroclor 1260	2.20E-02	1.11E-05	7.87E-05	1.34E-06	3.15E-05	2.00E-05		1.23E-02	8.66E-02		
Total PCBs	1.78E-01	1.11E-05	7.87E-05	1.34E-06	3.15E-05		2.00E+00			4.76E-07	1.12E-05
							Totals	**0.07**	**0.5**	**5E-07**	**1E-05**

RME green sunfish concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = Adjusted RME * Noncarcinogenic IF/RfD
Cancer Risk = Adjusted RME * Carcinogenic IF * Slope Factor

TABLE 5.48
SUMMARY OF HEALTH RISKS: ADULT RECREATIONAL RECEPTOR

Receptor/Pathway	Average Exposure		Reasonable Maximum Exposure	
	Chronic H.I.	Cancer Risk	Chronic H.I.	Cancer Risk
Adult Recreational Receptor				
Incidental Ingestion of Surface Water	0.0002	8E-10	0.001	1E-08
Dermal Contact with Surface Water	0.2	1E-06	1.70	2E-05
Ingestion of Channel Catfish	0.74	3E-06	5.22	6E-05
Ingestion of Green Sunfish	0.07	5E-07	0.5	1E-05
Incidental Ingestion of Sediments	0.003	1E-08	0.03	4E-07
Dermal Contact with Sediments	0.008	3E-08	0.29	4E-06
	1.0	**5E-06**	**7.7**	**9E-05**

Risk values from Tables 5.42 through 5.47.
Discrepancies in numbers are due to rounding.

TABLE 5.49
CHILD RECREATIONAL RECEPTOR HEALTH RISK: INCIDENTAL INGESTION OF SEDIMENTS

	Sediment Concentrations	Noncarcinogenic IF		Carcinogenic IF		Chronic		Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	2.30E+00	7.86E-08	6.29E-07	9.43E-09	7.55E-08	2.00E-05		9.04E-03	7.23E-02		
Aroclor 1248	4.00E-01	7.86E-08	6.29E-07	9.43E-09	7.55E-08	2.00E-05		1.57E-03	1.26E-02		
Total PCBs	2.38E+00	7.86E-08	6.29E-07	9.43E-09	7.55E-08		2.00E+00			4.49E-08	3.59E-07
							Totals	**0.01**	**0.08**	**4E-08**	**4E-07**

RME sediment concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.50
CHILD RECREATIONAL RECEPTOR HEALTH RISK: DERMAL CONTACT WITH SEDIMENTS

	Sediment Concentration	Noncarcinogenic IF		Carcinogenic IF		Chronic	Slope	Hazard Quotient		Cancer Risk	
	RME (mg/kg)	Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)	RfD (mg/kg-d)	Factor $(mg/kg\text{-}d)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	2.30E+00	8.92E-08	3.43E-06	1.07E-08	4.11E-07	2.00E-05		1.03E-02	3.94E-01		
Aroclor 1248	4.00E-01	8.92E-08	3.43E-06	1.07E-08	4.11E-07	2.00E-05		1.78E-03	6.85E-02		
Total PCBs	2.38E+00	8.92E-08	3.43E-06	1.07E-08	4.11E-07		2.00E+00			5.09E-08	1.96E-06
							Totals	**0.012**	**0.5**	**5E-08**	**2E-06**

RME sediment concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.51
CHILD RECREATIONAL RECEPTOR HEALTH RISK: INCIDENTAL INGESTION OF SURFACE WATER

	Surface Water	Noncarcinogenic IF		Carcinogenic IF		Chronic		Hazard Quotient		Cancer Risk	
	RME (mg/L)	Average (L/kg-day)	RME (L/kg-day)	Average (L/kg-day)	RME (L/kg-day)	RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Average	RME	Average	RME
PCBs											
Aroclor 1242	6.03E-04	7.86E-06	3.14E-05	9.43E-07	3.77E-06	2.00E-05		2.37E-04	9.48E-04		
Aroclor 1248	5.90E-05	7.86E-06	3.14E-05	9.43E-07	3.77E-06	2.00E-05		2.32E-05	9.28E-05		
Aroclor 1260	5.10E-05	7.86E-06	3.14E-05	9.43E-07	3.77E-06	2.00E-05		2.00E-05	8.02E-05		
Total PCBs	6.53E-04	7.86E-06	3.14E-05	9.43E-07	3.77E-06		2.00E+00			1.23E-09	4.93E-09
							Totals	**0.0003**	**0.001**	**1E-09**	**5E-09**

RME surface water concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.52
CHILD RECREATIONAL RECEPTOR HEALTH RISK: DERMAL CONTACT WITH SURFACE WATER

	Surface Water	Noncarcinogenic IF		Carcinogenic IF		Chronic	Slope	Hazard Quotient		Cancer Risk	
	RME	Average	RME	Average	RME	RfD	Factor	Average	RME	Average	RME
	(mg/L)	(L/kg-day)	(L/kg-day)	(L/kg-day)	(L/kg-day)	(mg/kg-d)	$(mg/kg\text{-}d)^{-1}$				
PCBs											
Aroclor 1242	6.03E-04	9.81E-03	7.54E-02	1.18E-03	9.04E-03	2.00E-05		2.96E-01	2.27E+00		
Aroclor 1248	5.90E-05	9.81E-03	7.54E-02	1.18E-03	9.04E-03	2.00E-05		2.89E-02	2.22E-01		
Aroclor 1260	5.10E-05	9.81E-03	7.54E-02	1.18E-03	9.04E-03	2.00E-05		2.50E-02	1.92E-01		
Total PCBs	6.53E-04	9.81E-03	7.54E-02	1.18E-03	9.04E-03		2.00E+00			1.54E-06	1.18E-05
							Totals	**0.35**	**2.69**	**2E-06**	**1E-05**

RME surface water concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table5.29)
Slope Factors (Table 5.30)
Hazard Quotient = Adjusted RME * Noncarcinogenic IF/RfD
Cancer Risk = Adjusted RME * Carcinogenic IF * Slope Factor

TABLE 5.53
CHILD RECREATIONAL RECEPTOR HEALTH RISK: INGESTION OF CHANNEL CATFISH

	Channel Catfish Concentrations RME (mg/kg)	Noncarcinogenic IF Average (kg/kg-day)	Noncarcinogenic IF RME (kg/kg-day)	Carcinogenic IF Average (kg/kg-day)	Carcinogenic IF RME (kg/kg-day)	Chronic RfD (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Hazard Quotient Average	Hazard Quotient RME	Cancer Risk Average	Cancer Risk RME
PCBs											
Aroclor 1248	2.80E-01	8.83E-06	6.35E-05	1.06E-06	7.62E-06	2.00E-05		1.24E-01	8.89E-01		
Aroclor 1254	9.58E-01	8.83E-06	6.35E-05	1.06E-06	7.62E-06	2.00E-05		4.23E-01	3.04E+00		
Aroclor 1260	8.80E-02	8.83E-06	6.35E-05	1.06E-06	7.62E-06	2.00E-05		3.89E-02	2.79E-01		
Total PCBs	1.01E+00	8.83E-06	6.35E-05	1.06E-06	7.62E-06		2.00E+00			2.14E-06	1.54E-05
							Totals	**0.59**	**4.21**	**2E-06**	**2E-05**

RME Channel Catfish concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = RME * Noncarcinogenic IF/RfD
Cancer Risk = RME * Carcinogenic IF * Slope Factor

TABLE 5.54
CHILD RECREATIONAL RECEPTOR HEALTH RISK: INGESTION OF GREEN SUNFISH

	RME Sunfish Tissue Concentration (mg/kg)	Noncarcinogenic IF		Carcinogenic IF		Chronic RfD (mg/kg-d)	Slope Factor $(mg/kg\text{-}d)^{-1}$	Hazard Quotient		Cancer Risk	
		Average (kg/kg-day)	RME (kg/kg-day)	Average (kg/kg-day)	RME (kg/kg-day)			Average	RME	Average	RME
PCBs											
Aroclor 1248	3.20E-02	8.83E-06	6.35E-05	1.06E-06	7.62E-06	2.00E-05		1.41E-02	1.02E-01		
Aroclor 1254	7.20E-02	8.83E-06	6.35E-05	1.06E-06	7.62E-06	2.00E-05		3.18E-02	2.28E-01		
Aroclor 1260	2.20E-02	8.83E-06	6.35E-05	1.06E-06	7.62E-06	2.00E-05		9.71E-03	6.98E-02		
Total PCBs	1.78E-01	8.83E-06	6.35E-05	1.06E-06	7.62E-06		2.00E+00			3.77E-07	2.71E-06
							Totals	**0.06**	**0.40**	**4E-07**	**3E-06**

RME Green Sunfish concentrations from Table 5.17
RME = Reasonable Maximum Exposure
IF = Intake Factor (Table 5.28)
RfD = Reference Dose (Table 5.29)
Slope Factors (Table 5.30)
Hazard Quotient = Adjusted RME * Noncarcinogenic IF/RfD
Cancer Risk = Adjusted RME * Carcinogenic IF * Slope Factor

TABLE 5.55
SUMMARY OF HEALTH RISKS FOR CHILD RECREATIONAL RECEPTOR EXPOSURES

Receptor/Pathway	Average Exposure		Reasonable Maximum Exposure	
	Chronic H.I.	Cancer Risk	Chronic H.I.	Cancer Risk
Child Recreational Receptor				
Incidental Ingestion of Surface Water	0.0003	1E-09	0.001	5E-09
Dermal Contact with Surface Water	0.35	2E-06	2.69	1E-05
Ingestion of Channel Catfish	0.59	2E-06	4.21	2E-05
Ingestion of Green Sunfish	0.06	4E-07	0.4	3E-06
Incidental Ingestion of Sediments	0.01	4E-08	0.08	4E-07
Dermal Contact with Sediments	0.012	5E-08	0.5	2E-06
	1.0	**4E-06**	**7.8**	**4E-05**

Risk values from Tables 5.49 through 5.54.
Discrepancies in numbers are due to rounding.

TABLE 5.56
SUMMARY OF HEALTH RISKS

Receptor/Pathway	Average Exposure		Reasonable Maximum Exposure	
	Chronic H.I.	Cancer Risk	Chronic H.I.	Cancer Risk
Excavation Worker				
Incidental Ingestion of Deep Soil	0.003	5E-09	0.01	4E-08
Dermal Contact with Deep Soil	0.006	9E-09	0.09	3E-07
	0.01	**1E-08**	**0.10**	**3E-07**
Utility Worker				
Incidental Ingestion of Shallow Soil	0.01	8E-10	0.04	6E-09
Dermal Contact with Shallow Soil	0.018	1E-09	0.29	5E-08
	0.03	**2E-09**	**0.33**	**6E-08**
Construction Worker				
Incidental Ingestion of Surface Water	0.001	7E-11	0.002	3E-10
Dermal Contact with Surface Water	1.91	1E-07	3.16	4E-07
Incidental Ingestion of Sediment	1.88	1E-07	7.5	1E-06
Dermal Contact with Sediment	3.32	2E-07	55.0	8E-06
	7.1	**4E-07**	**66**	**9E-06**
Adult Recreational Receptor				
Incidental Ingestion of Surface Water	0.0002	8E-10	0.001	1E-08
Dermal Contact with Surface Water	0.2	1E-06	1.70	2E-05
Ingestion of Channel Catfish	0.74	3E-06	5.22	6E-05
Ingestion of Green Sunfish	0.07	5E-07	0.5	1E-05
Incidental Ingestion of Sediment	0.003	1E-08	0.03	4E-07
Dermal Contact with Sediment	0.008	3E-08	0.29	4E-06
	1.0	**5E-06**	**7.7**	**9E-05**
Child Recreational Receptor				
Incidental Ingestion of Surface Water	0.0003	1E-09	0.001	5E-09
Dermal Contact with Surface Water	0.35	2E-06	2.69	1E-05
Ingestion of Channel Catfish	0.59	2E-06	4.21	2E-05
Ingestion of Green Sunfish	0.06	4E-07	0.4	3E-06
Incidental Ingestion of Sediment	0.01	4E-08	0.08	4E-07
Dermal Contact with Sediment	0.012	5E-08	0.5	2E-06
	1.0	**4E-06**	**7.9**	**4E-05**

Risk values are from Tables 5.31 through 5.55.
Discrepancies in numbers are due to rounding.

Table 5.57
Comparison of Benthos and Fish Tissue PCB Concentrations

Location	Sediment PCB Concnetration (mg/kg dw)	Benthos PCB Concentration (mg/kg ww)	Forage Fish (mg/kg ww)	PCB Ratio Benthos:Fish	Source
Federal Dam	2.793	6.286	1.66	3.79	USEPA (1999)
RM 143.5	0.86	0.876	1.93	0.45	USEPA (1999)
RM 137.2	1.519	1.725	3.9	0.44	USEPA (1999)
RM 122.4	0.963	0.804	1.49	0.54	USEPA (1999)
RM 113.8	1.009	0.691	1.56	0.44	USEPA (1999)
RM 100	0.399	0.38	0.68	0.56	USEPA (1999)
RM 88.9	0.781	0.191	1.35	0.14	USEPA (1999)
RM 58.7	0.252	0.491	1.47	0.33	USEPA (1999)
RM 47.3	1.537	0.666	1.3	0.51	USEPA (1999)
RM 25.8	0.578	0.197	0.98	0.20	USEPA (1999)
			mean	0.74	
			median	0.45	

RM = Hudson River Mile

* Concentrations were reported as dry weight and were converted to wet weight based on an average dry weight of 13% reported in study.

EPA. 1999. Phase 2 Report – Review Copy. Further Site Characterization and Analysis, Volume 2E Ecological Risk Assessment, Hudson River PCBs Reassessment RI/FS. United States Environmental Protection Agency, Region II.

Table 5.58
Summary of Lipid Concentrations in Green Sunfish

Date Sampled	Site Location	Sample Location	Species	Lipid Content	Units
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.128	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.227	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.177	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.088	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.077	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.082	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.093	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.189	%
Sep-92	Boone Creek	BCK0.2	Gr. Sunfish	0.216	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.189	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.672	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.102	%
Sep-92	Blue River	BLK21	Gr. Sunfish	1.16	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.106	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.036	%
Sep-92	Blue River	BLK21	Gr. Sunfish	2.606	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.214	%
Sep-92	Blue River	BLK21	Gr. Sunfish	0.2	%
Sep-92	Blue River	BLK25	Gr. Sunfish	0.171	%
Sep-92	Blue River	BLK25	Gr. Sunfish	0	%
Sep-92	Blue River	BLK25	Gr. Sunfish	0.317	%
Sep-92	Blue River	BLK25/26	Gr. Sunfish	0.194	%
Sep-92	Blue River	BLK26	Gr. Sunfish	0.14	%
Sep-92	Blue River	BLK26	Gr. Sunfish	0.145	%
Sep-92	Blue River	BLK26	Gr. Sunfish	0.135	%
Sep-92	Blue River	BLK26	Gr. Sunfish	0.153	%
Sep-92	Blue River	BLK26	Gr. Sunfish	0.153	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.366	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.224	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.183	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.356	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.273	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.149	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.047	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.347	%
Sep-92	Blue River	BLK27	Gr. Sunfish	0.181	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.125	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.178	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.259	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.139	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.198	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.224	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.112	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.144	%
Sep-92	Blue River	BLK31	Gr. Sunfish	0.149	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.241	%

Table 5.58
Summary of Lipid Concentrations in Green Sunfish

Date Sampled	Site Location	Sample Location	Species	Lipid Content	Units
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.116	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.121	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.582	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.15	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.34	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.384	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.078	%
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.184	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.459	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.119	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.089	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.451	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.445	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.342	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.186	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.204	%
Sep-92	Indian Creek	ICK1.0	Gr. Sunfish	0.118	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.198	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.131	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.219	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.2	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.354	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	1.031	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.217	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.118	%
Sep-92	Indian Creek	ICK3.0	Gr. Sunfish	0.027	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.19	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	1.00	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.27	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.17	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.15	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.19	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.26	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.23	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	0.32	%
Oct-93	Boone Creek	BCK0.2	Gr. Sunfish	1.65	%
Oct-93	Blue River	BLK25	Gr. Sunfish	1.94	%
Oct-93	Blue River	BLK25	Gr. Sunfish	2.34	%
Oct-93	Blue River	BLK25	Gr. Sunfish	3.00	%
Oct-93	Blue River	BLK25	Gr. Sunfish	1.10	%
Oct-93	Blue River	BLK25	Gr. Sunfish	2.58	%
Oct-93	Blue River	BLK27	Gr. Sunfish	5.23	%
Oct-93	Blue River	BLK27	Gr. Sunfish	0.86	%
Oct-93	Blue River	BLK27	Gr. Sunfish	2.04	%
Oct-93	Blue River	BLK27	Gr. Sunfish	1.38	%
Oct-93	Blue River	BLK27	Gr. Sunfish	4.95	%

Table 5.58
Summary of Lipid Concentrations in Green Sunfish

Date Sampled	Site Location	Sample Location	Species	Lipid Content	Units
Oct-93	Blue River	BLK27	Gr. Sunfish	1.75	%
Oct-93	Blue River	BLK27	Gr. Sunfish	1.44	%
Oct-93	Blue River	BLK27	Gr. Sunfish	2.01	%
Oct-93	Blue River	BLK27	Gr. Sunfish	1.90	%
Oct-93	Blue River	BLK31	Gr. Sunfish	55.70	%
Oct-93	Blue River	BLK31	Gr. Sunfish	2.68	%
Oct-93	Blue River	BLK31	Gr. Sunfish	1.41	%
Oct-93	Blue River	BLK31	Gr. Sunfish	0.52	%
Oct-93	Blue River	BLK31	Gr. Sunfish	0.93	%
Oct-93	Blue River	BLK31	Gr. Sunfish	0.69	%
Oct-93	Blue River	BLK31	Gr. Sunfish	1.89	%
Oct-93	Blue River	BLK31	Gr. Sunfish	0.71	%
Oct-93	Blue River	BLK31	Gr. Sunfish	0.38	%
Oct-93	Blue River	BLK31	Gr. Sunfish	2.50	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.01	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.01	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.02	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.01	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.03	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.02	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.01	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.02	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.08	%
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish	0.02	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	4.27	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	0.01	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	0.05	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	0.10	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	0.11	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	3.65	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	6.14	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	30.68	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	15.61	%
Oct-93	Indian Creek	ICK1.0	Gr. Sunfish	4.88	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.22	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.54	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	2.65	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.29	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.41	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.17	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.13	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.13	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.23	%
Oct-93	Indian Creek	ICK3.0	Gr. Sunfish	0.29	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	1.16	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	1.59	%

Table 5.58
Summary of Lipid Concentrations in Green Sunfish

Date Sampled	Site Location	Sample Location	Species	Lipid Content	Units
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.862	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.807	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	1.06	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.633	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.829	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.888	%
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.961	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	2.02	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	0.798	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	0.797	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	1.21	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	0.721	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	1.46	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	0.537	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	0.83	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	1.12	%
Jul-98	Indian Creek	ICK1.0	Gr. Sunfish	1.03	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.925	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	1.53	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	1.49	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.691	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.734	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.911	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.993	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.709	%
Jul-98	Indian Creek	ICK3.0	Gr. Sunfish	0.726	%
			Mean	1.4	
			Count	164	

TABLE 5.59
FISH TISSUE DATA FROM SITES ICK 0.2, BRK27, BRK26 AND BRK25

Date Sampled	Site Location	Sample Location	Species	Detection Limit	Aroclor 1248	Aroclor 1254	Aroclor 1260	Reported Total PCBs Results	Unit	Lipids Results	Unit	Calculated Total PCBs in Fillet (mg/kg)	Wholebody Total PCBs (mg/kg)
Apr-91	Blue River	BLK25	Ch. Catfish	0.01	0.17	0.78	0.005	0.95	ug/g			0.955	1.34
Apr-91	Blue River	BLK25	Ch. Catfish	0.01	0.11	0.72	0.02	0.85	ug/g			0.850	1.19
Apr-91	Blue River	BLK25	Ch. Catfish	0.01	0.19	0.69	0.22	1.1	ug/g			1.100	1.54
Apr-91	Blue River	BLK25	Ch. Catfish	0.01	0.15	0.9	0.005	1.05	ug/g			1.055	1.48
Apr-91	Blue River	BLK25	Ch. Catfish	0.01	0.13	0.77	0.005	0.9	ug/g			0.905	1.27
Apr-91	Blue River	BLK25	Ch. Catfish	0.01	0.16	0.43	0.05	0.64	ug/g			0.640	0.90
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				1598.5	ng/g	2.074	%	1.599	2.24
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				848.3	ng/g	1.29	%	0.848	1.19
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				359.7	ng/g	1.846	%	0.360	0.50
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				1122.8	ng/g	2.439	%	1.123	1.57
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				1027.1	ng/g	3.018	%	1.027	1.44
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				622.3	ng/g	2.278	%	0.622	0.87
Sep-92	Blue River	BLK25	Ch. Catfish	0.01				999.2	ng/g	2.223	%	0.999	1.40
Sep-92	Blue River	BLK25	Gr. Sunfish	0.01				100	ng/g	0.171	%	0.100	0.26
Sep-92	Blue River	BLK25	Gr. Sunfish	0.01				245	ng/g	0	%	0.245	0.64
Sep-92	Blue River	BLK25	Gr. Sunfish	0.01				144.3	ng/g	0.317	%	0.144	0.38
Oct-93	Blue River	BLK25	Gr. Sunfish					157.77	ng/g	1.94	%	0.158	0.41
Oct-93	Blue River	BLK25	Gr. Sunfish					251.74	ng/g	2.34	%	0.252	0.65
Oct-93	Blue River	BLK25	Gr. Sunfish					239.59	ng/g	3.00	%	0.240	0.62
Oct-93	Blue River	BLK25	Gr. Sunfish					119.46	ng/g	1.10	%	0.119	0.31
Oct-93	Blue River	BLK25	Gr. Sunfish					102.01	ng/g	2.58	%	0.102	0.27
Sep-92	Blue River	BLK25/26	Gr. Sunfish	0.01				169.4	ng/g	0.194	%	0.169	0.44
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.05	0.01	0.06	ug/g			0.065	0.17
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.01	0.01	0.02	ug/g			0.025	0.07
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.005	0.005		ug/g			0.015	0.04
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.03	0.06	0.01	0.1	ug/g			0.100	0.26
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.01	0.005	0.01	ug/g			0.020	0.05
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.02	0.01	0.03	ug/g			0.035	0.09
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.02	0.01	0.03	ug/g			0.035	0.09
Apr-91	Blue River	BLK26	Gr. Sunfish	0.01	0.005	0.01	0.005	0.01	ug/g			0.020	0.05
Sep-92	Blue River	BLK26	Gr. Sunfish	0.01				161.7	ng/g	0.14	%	0.162	0.42
Sep-92	Blue River	BLK26	Gr. Sunfish	0.01				76	ng/g	0.145	%	0.076	0.20

TABLE 5.59
FISH TISSUE DATA FROM SITES ICK 0.2, BRK27, BRK26 AND BRK25

Date Sampled	Site Location	Sample Location	Species	Detection Limit	Aroclor 1248	Aroclor 1254	Aroclor 1260	Reported Total PCBs Results	Unit	Lipids Results	Unit	Calculated Total PCBs in Fillet (mg/kg)	Wholebody Total PCBs (mg/kg)
Sep-92	Blue River	BLK26	Gr. Sunfish	0.01				171.9	ng/g	0.135	%	0.172	0.45
Sep-92	Blue River	BLK26	Gr. Sunfish	0.01				78.5	ng/g	0.153	%	0.079	0.20
Sep-92	Blue River	BLK26	Gr. Sunfish	0.01				183.4	ng/g	0.153	%	0.183	0.48
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.01	0.05	0.005	0.06	ug/g			0.065	0.17
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.08	0.14	0.04	0.26	ug/g			0.260	0.68
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.005	0.02	0.01	0.03	ug/g			0.035	0.09
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.005	0.02	0.01	0.03	ug/g			0.035	0.09
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.01	0.07	0.02	0.1	ug/g			0.100	0.26
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.005	0.18	0.01	0.18	ug/g			0.195	0.51
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.2	0.26	0.03	0.49	ug/g			0.490	1.27
Apr-91	Blue River	BLK27	Gr. Sunfish	0.01	0.005	0.02	0.01	0.03	ug/g			0.035	0.09
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				134.2	ng/g	0.366	%	0.134	0.35
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				153.2	ng/g	0.224	%	0.153	0.40
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				93.5	ng/g	0.183	%	0.094	0.24
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				160.2	ng/g	0.356	%	0.160	0.42
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				152.9	ng/g	0.273	%	0.153	0.40
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				55.6	ng/g	0.149	%	0.056	0.14
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				66.5	ng/g	0.047	%	0.067	0.17
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				141.3	ng/g	0.347	%	0.141	0.37
Sep-92	Blue River	BLK27	Gr. Sunfish	0.01				118.2	ng/g	0.181	%	0.118	0.31
Oct-93	Blue River	BLK27	Gr. Sunfish					572.36	ng/g	5.23	%	0.572	1.49
Oct-93	Blue River	BLK27	Gr. Sunfish					78.93	ng/g	0.86	%	0.079	0.21
Oct-93	Blue River	BLK27	Gr. Sunfish					220.66	ng/g	2.04	%	0.221	0.57
Oct-93	Blue River	BLK27	Gr. Sunfish					131.68	ng/g	1.38	%	0.132	0.34
Oct-93	Blue River	BLK27	Gr. Sunfish					307.48	ng/g	4.95	%	0.307	0.80
Oct-93	Blue River	BLK27	Gr. Sunfish					115.24	ng/g	1.75	%	0.115	0.30
Oct-93	Blue River	BLK27	Gr. Sunfish					277.87	ng/g	1.44	%	0.278	0.72
Oct-93	Blue River	BLK27	Gr. Sunfish					174.85	ng/g	2.01	%	0.175	0.45
Oct-93	Blue River	BLK27	Gr. Sunfish					175.92	ng/g	1.90	%	0.176	0.46
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.03	0.09	0.03	0.15	ug/g			0.150	0.39
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.03	0.01	0.02	0.06	ug/g			0.060	0.16
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.005	0.12	0.05	0.17	ug/g			0.175	0.46

TABLE 5.59
FISH TISSUE DATA FROM SITES ICK 0.2, BRK27, BRK26 AND BRK25

Date Sampled	Site Location	Sample Location	Species	Detection Limit	Aroclor 1248		Aroclor 1254		Aroclor 1260		Reported Total PCBs Results	Unit	Lipids Results	Unit	Calculated Total PCBs in Fillet (mg/kg)	Wholebody Total PCBs (mg/kg)
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.09		0.04		0.02		0.15	ug/g			0.150	0.39
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.005		0.005		0.005		0.005	ug/g			0.015	0.04
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.005		0.005		0.005		0.005	ug/g			0.015	0.04
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.03		0.09		0.03		0.15	ug/g			0.150	0.39
Apr-91	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.03		0.03		0.01		0.07	ug/g			0.070	0.18
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							188.2	ng/g	0.241	%	0.188	0.49
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							70.3	ng/g	0.116	%	0.070	0.18
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							74.8	ng/g	0.121	%	0.075	0.19
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							542.7	ng/g	0.582	%	0.543	1.41
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							95.9	ng/g	0.15	%	0.096	0.25
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							249.5	ng/g	0.34	%	0.250	0.65
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							164.4	ng/g	0.384	%	0.164	0.43
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							76.1	ng/g	0.078	%	0.076	0.20
Sep-92	Indian Creek	ICK0.2	Gr. Sunfish	0.01							149.8	ng/g	0.184	%	0.150	0.39
Oct-93	Indian Creek	ICK0.2	Ch. Catfish								398.32	ng/g	0.16	%	0.398	0.56
Oct-93	Indian Creek	ICK0.2	Ch. Catfish								86.79	ng/g	0.05	%	0.087	0.12
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								93.47	ng/g	0.01	%	0.093	0.24
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								93.36	ng/g	0.01	%	0.093	0.24
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								54.84	ng/g	0.02	%	0.055	0.14
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								56.83	ng/g	0.01	%	0.057	0.15
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								208.71	ng/g	0.03	%	0.209	0.54
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								111.05	ng/g	0.02	%	0.111	0.29
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								635.52	ng/g	0.01	%	0.636	1.65
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								86.33	ng/g	0.02	%	0.086	0.22
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								2925.84	ng/g	0.08	%	2.926	7.61
Oct-93	Indian Creek	ICK0.2	Gr. Sunfish								251.30	ng/g	0.02	%	0.251	0.65
Jul-98	Indian Creek	ICK0.2	Ch. Catfish	0.01	0.18		0.005	U	0.042	P	0.222	ug/g	3.71	%	0.227	0.32
Jul-98	Indian Creek	ICK0.2	Ch. Catfish	0.01	0.16	P	0.005	U	0.077	P	0.237	ug/g	3.26	%	0.242	0.34
Jul-98	Indian Creek	ICK0.2	Ch. Catfish	0.01	0.33		0.005	U	0.055	P	0.385	ug/g	5.57	%	0.390	0.55
Jul-98	Indian Creek	ICK0.2	Ch. Catfish	0.01	0.16	P	0.005	U	0.033		0.193	ug/g	4.52	%	0.198	0.28
Jul-98	Indian Creek	ICK0.2	Ch. Catfish	0.01	0.17		0.005	U	0.04	P	0.21	ug/g	5.18	%	0.215	0.30
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.15		0.005	U	0.028	JP	0.178	ug/g	1.16	%	0.183	0.48

TABLE 5.59
FISH TISSUE DATA FROM SITES ICK 0.2, BRK27, BRK26 AND BRK25

Date Sampled	Site Location	Sample Location	Species	Detection Limit	Aroclor 1248		Aroclor 1254		Aroclor 1260		Reported Total PCBs Results	Unit	Lipids Results	Unit	Calculated Total PCBs in Fillet (mg/kg)	Wholebody Total PCBs (mg/kg)
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	1.4		0.005	U	0.005	U	1.4	ug/g	1.59	%	1.410	3.67
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.045	JP	0.005	U	0.005	U	0.045	ug/g	0.862	%	0.055	0.14
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.043	JP	0.005	U	0.025	JP	0.068	ug/g	0.807	%	0.073	0.19
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.068		0.005	U	0.031	JP	0.099	ug/g	1.06	%	0.104	0.27
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.13		0.005	U	0.033	JP	0.163	ug/g	0.633	%	0.168	0.44
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.005	U	0.005	U	0.082	JP	0.082	ug/g	0.829	%	0.092	0.24
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.005	U	0.005	U	0.045	P	0.045	ug/g	0.888	%	0.055	0.14
Jul-98	Indian Creek	ICK0.2	Gr. Sunfish	0.01	0.15		0.005	U	0.005	U	0.15	ug/g	0.961	%	0.160	0.42

Table 5.60
Measures of Receptor Characteristics

Receptor	Body Weight (kg)	Area Use (km)	Food Ingestion Rate (kg ww/day)	Water Ingestion Rate (L/day)	Sediment Ingestion Rate (kg/day)	Dietary Content Aquatic Benthic Invertebrates	Dietary Content Fish
Tree Swallow	0.017	2	0.018	0.004	0	1	0
Little Brown bat	0.0078	12	0.0028	0.0014	0	1	0
Belted Kingfisher	0.148	1.2	0.074	0.016	0	0.14	0.86
Great blue heron	2.23	3.1	0.401	0.1	0	0	1
Mink	1	1.85	0.137	0.099	0.013	0.15	0.85

Tree Swallow

Area Use – lower foraging range for females (Robertson et al 1992, as reported in Sample et al. 1997)

Body Weight – Lower end of range (Secord and McCarty 1997 in USEPA 1999)

Food Ingestion Rate – Robertson et al. 1992 in USEPA 1999

Water Ingestion Rate - Calder and Braun 1983 in USEPA 1993

Dietary Composition - Sample et al. 1997

Soil/Sediment Ingestion Rate – Assumed negligible

Little Brown Bat

Area Use – Sample et al. 1997

Body Weight – Average of adult bats reported in Silva and Downing 1995

Food Ingestion Rate – Based on average of adult and lactating bats of (0.36g/g-day) in Anthony and Kunz 1977 in Sample et al. 1997

Water Ingestion Rate - Based on 0.18L/kg-day; Coutts et al. 1973 in Sample et al. 1997

Dietary Composition - Assumed to consist entirely of insects

Soil/Sediment Ingestion Rate – Assumed negligible

Kingfisher

Area Use - average of shoreline used in Pennsylvania and Ohio streams; Brooks & Davis 1987 and Davis 1980 in USEPA 1993

Body weight - Mean size of adults reported for Pennsylvania and Ohio; Brooks and Davis 1987 in USEPA 1993

Food Ingestion Rate - Based on value for adults in Alexander 1977 from USEPA 1993.

Water Ingestion Rate - from USEPA 1993

Table 5.60
Measures of Receptor Characteristics

Dietary Composition - Davis 1982 in Sample and Suter 1994

Soil/Sediment Ingestion Rate – Assumed negligible

Great Blue Heron

Area Use - Mean feeding territories reported by Bayer 1978 in USEPA 1993, assuming 1 ha is approximatley equal to 1 km shoreline

Body weight - USEPA 1993

Food Ingestion Rate - based on 0.18 g/g/day; Kushlan 1978 in USEPA 1993

Water Ingestion Rate - USEPA 1993

Dietary Composition - Assumed to consist entirely of fish

Soil/Sediment Ingestion Rate – Assumed negligible

Mink

Area Use – Lower linear range reported in Sample and Suter 1994

Body Weight – Mean of males and Females: USEPA 1999

Food Ingestion Rate – Bleavins and Aulerich 1981 as reported in Sample and Suter 1994

Water Ingestion Rate - Sample et al. 1994

Dietary Composition - 15% aquatic invertebrates per Sample and Suter 1994; remainder assumed to consist entirely of fish

Soil/Sediment Ingestion Rate –Sample and Suter 1994

Table 5.61
Ecological Effects Quotients

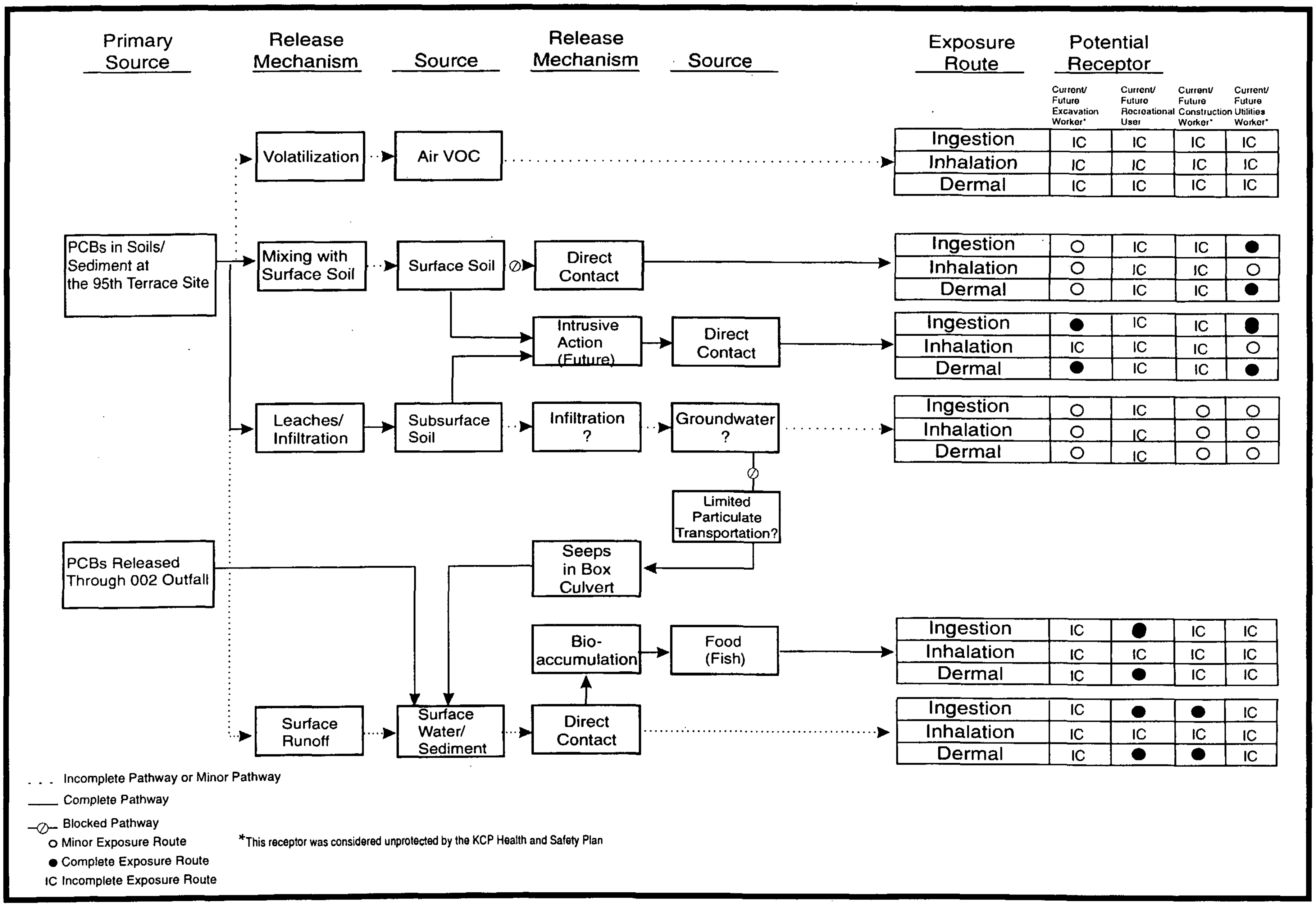
Receptor	C_{fish} (mg/kg)	C_{inv} (mg/kg)	C_{sed} (mg/kg)	C_{wat} (mg/L)	Food Ingestion Rate (kg/day)	Water Ingestion Rate (L/day)	Sediment Ingestion Rate (kg/day)	Area Use Factor	Body Weight (kg)
Little Brown bat	0	0.68	- -	0.00005	0.0028	0.0014	0	1	0.0078
Tree Swallow	0	0.68	- -	0.00005	0.018	0.004	0	1	0.017
Belted Kingfisher	0.68	0.68	- -	0.00005	0.074	0.016	0	1	0.148
Great blue heron	0.68	0.68	- -	0.00005	0.401	0.1	0	1	2.23
Mink	0.68	0.68	0.14	0.00005	0.137	0.099	0.013	1	1

Receptor	Dietary Fraction Aquatic Benthic Invertebrates[a]	Dietary Fraction Fish[a]	ADD (mg/kg-day)	NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL EEQ	LOAEL EEQ
Little Brown bat	1	0	0.24	0.32	1.5	0.8	0.2
Tree Swallow	1	0	0.72	0.86	1.31	0.8	0.5
Belted Kingfisher	0.14	0.86	0.34	0.86	1.31	0.4	0.3
Great blue heron	0	1	0.12	0.86	1.31	0.1	0.1
Mink	0.15	0.85	0.09	0.14	0.15	0.7	0.6

[a] expressed as a decimal fraction
C_{fish} - concentration in fish
C_{inv} - concentration in invertebrates
C_{sed} - concentration in sediment
C_{wat} - concentration in water

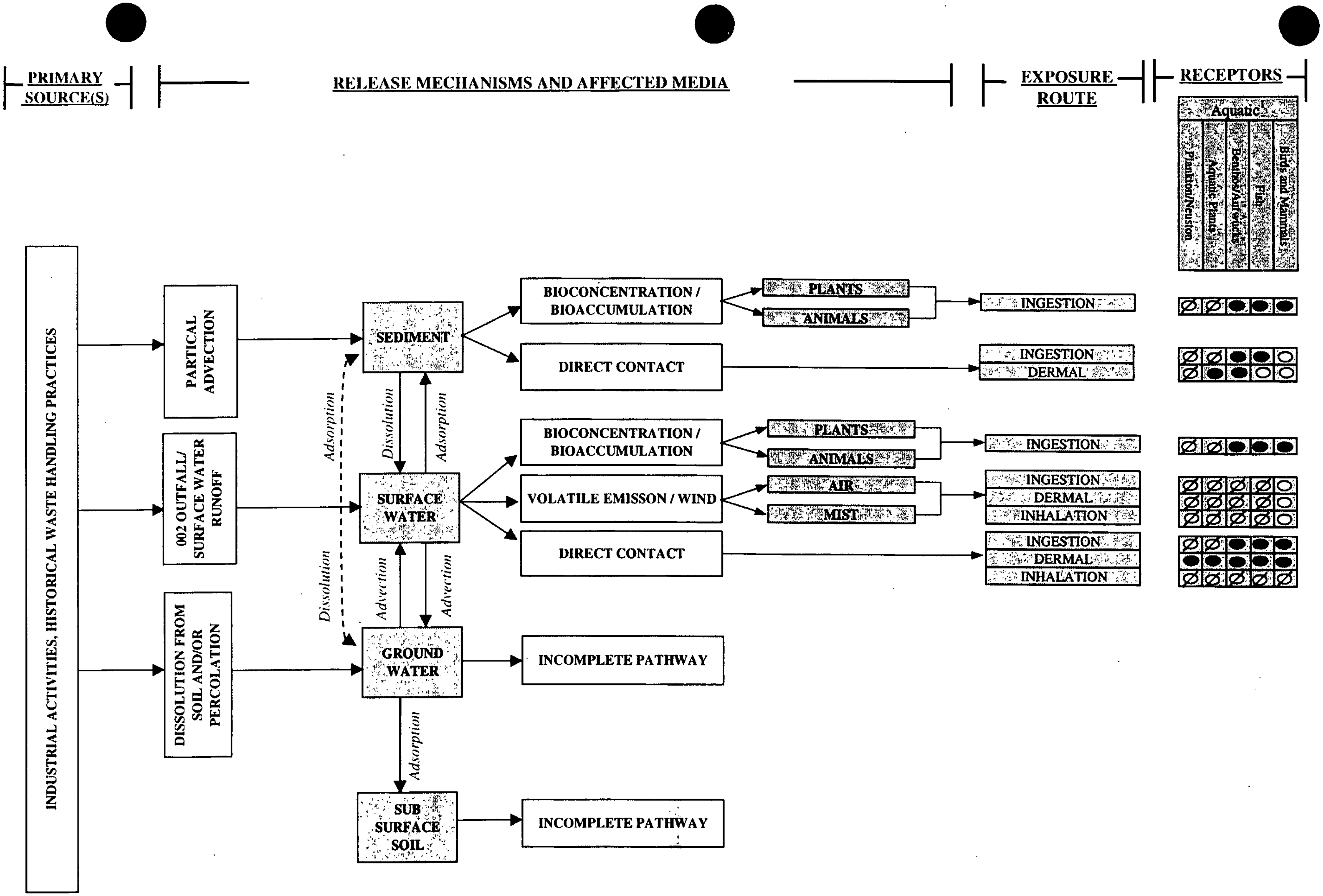
- - Exposure Concentration in sediment not estimated, since sediment ingestion assumed negligible.
ADD - Average Daily Dose
NOAEL - no observed adverse effect level
LOAEL - lowest observed adverse effect level
TRV - Toxicity Reference Value

FIGURE 5.1 Site Conceptual Exposure Model



Graphics\FS19990400\FIG5.1-1.CDR 06/27/01

URS Woodward Clyde



NOTE:
DASHED LINES REPRESENT SECONDARY PATHWAYS

● Potentially Complete Pathway
○ Minor or Insignificant Pathway
Ø Incomplete Pathway

Exposure pathway for terristrial receptors is considered insignificant hence not presented.
[1]Aquatic consumers include fully aquatic and semiaquatic animals

DRN BY CC	DATE 07/02/01	SITE CONCEPTUAL EXPOSURE MODEL ECOLOGICAL EXPOSURES	FIG. NO. 5.2
CHK'D BY	REVISIONS: 0		

Attachments

Human Health and Ecological Risk Assessments

Attachment 5.1

Wholebody Total PCBs (mg/kg)	Wholebody Total PCBs in Channel Catfish and Green Sunfish (mg/kg)
Tissue	Sites ICK 0.2, BRK 27, BRK 26, and BRK25

(Nondetect data presented as 1/2 the DL)

Units = PPM

Sample#	Value	Qualifier	Sample#	Value	Qualifier	Sample#	Value	Qualifier
1	1.337		51	0.36738		101	0.4368	
2	1.19		52	0.30732		102	0.2392	
3	1.54		53	1.488136		103	0.143	
4	1.477		54	0.205218		104	0.416	
5	1.267		55	0.573716				
6	0.896		56	0.342368				
7	2.2379		57	0.799448				
8	1.18762		58	0.299624				
9	0.50358		59	0.722462				
10	1.57192		60	0.45461				
11	1.43794		61	0.457392				
12	0.87122		62	0.39				
13	1.39888		63	0.156				
14	0.26		64	0.455				
15	0.637		65	0.39				
16	0.37518		66	0.039				
17	0.4102		67	0.039				
18	0.65452		68	0.39				
19	0.62293		69	0.182				
20	0.3106		70	0.48932				
21	0.26523		71	0.18278				
22	0.44044		72	0.19448				
23	0.169		73	1.41102				
24	0.065		74	0.24934				
25	0.039		75	0.6487				
26	0.26		76	0.42744				
27	0.052		77	0.19786				
28	0.091		78	0.38948				
29	0.091		79	0.557648				
30	0.052		80	0.121506				
31	0.42042		81	0.243022				
32	0.1976		82	0.242736				
33	0.44694		83	0.142584				
34	0.2041		84	0.147758				
35	0.47684		85	0.542646				
36	0.169		86	0.28873				
37	0.676		87	1.652352				
38	0.091		88	0.224458				
39	0.091		89	7.607184				
40	0.26		90	0.65338				
41	0.507		91	0.3178				
42	1.274		92	0.3388				
43	0.091		93	0.546				
44	0.34892		94	0.2772				
45	0.39832		95	0.301				
46	0.2431		96	0.4758				
47	0.41652		97	3.666				
48	0.39754		98	0.143				
49	0.14456		99	0.1898				
50	0.1729		100	0.2704				

Number of Values	104
Percent Detection	100.00%
Percent of Detections J-coded	0.00%

The data are best described as log-normally distributed and there were a sufficient number of detected values to perform statistical analysis.

Use the MVUE of the log-normal mean and the Jackknifed MVUE derived confidence intervals for the Environmental Exposure Concentrations

RECOMMENDED ENVIRONMENTAL EXPOSURE CONCENTRATION VALUES

Low-End EEC	0.57	MVUE of the log-mean
High-End EEC	0.68	UCL of Jackknifed MVUE

Raw Data Results	
Normal Mean	5.88E-01
Standard Deviation	8.78E-01
Coefficient of Variance (%)	149.27%
Maximum Detection	7.61E+00
Minimum Detection	3.90E-02
Maximum Non-detection[1]	All Detects
Minimum Non-detection[1]	All Detects
Tested for Normality using the	D-Test
Normality Test Result (alpha = 0.05)	Fail
Critical Value	-2.544 or 1.312
Calculated Value for dataset	-36.233
90% UCL using CLT	6.99E-01
95% UCL using CLT	7.30E-01
Natural Log-Transformed Results	
MVUE of the log-mean	5.66E-01
Standard error of the log-mean[2]	6.85E-02
Tested for Normality using the	D-Test
Normality Test Result (alpha = 0.05)	Pass
Critical Value	-2.544 or 1.312
Calculated Value for dataset	-1.955
90% UCL of the MVUE[2]	6.53E-01
95% UCL of the MVUE[2]	6.79E-01
NonParametric Results	
Jackknifed Mean	5.88E-01
Jackknifed Standard Error	8.61E-02
90% UCL of the mean	6.99E-01
95% UCL of the mean	7.31E-01

1 = Equals 1/2 of the reported detection limit
2 = Using the Jackknife

EEC=Environmental Exposure Concentration
MVUE=Minimum Variance Unbiased Estimator
CLT=Central Limit Therom
UCL=Upper Confidence Interval

Polychlorinated Biphenyls Oral Toxicity - Mammals							
Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rat	LD_{50}	Not Reported	1016	Mortality		2300	RTECS, National Technical Information Service PB85-143766
Rat (Male - S/D)	LD_{50}	Single Dose	1242	Mortality	gavage in oil	4,250	Bruckner et al. 1973 as cited in ATDSR 1996
Rat (NS)	LD_{50}	Not Reported	1242	Mortality		794-1269	HSDB, USEPA, AWQCD: PCBs, p. C-35 (1980) EPA 440/5-80-068
Rat (NS)	LD_{50}	Single dose	1242	Mortality		800-8700	EPA 1980, NAS 1979 as cited in Eisler 1986
Mink	LD_{50}	Not Reported	1242	Mortality		3	Aulerich & Ringer 1977 as cited in Eisler 1986
Mink	LD_{50}	9 months	1242	Mortality	8.6 mg/kg diet	2	Ringer 1983 as cited in Eisler 1986
Rat (NS)	LD_{50}	Single dose	1248	Mortality		800-11,000	EPA 1980, NAS 1979 as cited in Eisler 1986
Rat	LD_{50}	Not Reported	1248	Mortality		11,000	RTECS, Annual Review of Pharmacology 14:139, 1974
Rat	LD_{50}	Single dose	1254	Mortality		500 - 1400	Hudson et al. 1984 as cited in Eisler 1986
Rat (Male - O/M)	LD_{50}	Single dose	1254	Mortality	gavage in oil	1010	Garthoff et al. 1981 as cited in ATSDR 1996
Rat (Male - S)	LD_{50}	Single dose	1254	Mortality	gavage in oil	1295	Linder et al 1974 as cited in ATSDR 1996
Rat	LD_{10}	8-month	1254	Mortality	500 mg/kg-diet	40.8	EPA 440/5-80-068, 1980
Mouse (Male - ICR)	LD_{50}	2-week	1254	Mortality	in diet but conc. not provided	130	Sanders et al. 1974 as cited in ATSDR 1996
White-footed mouse	LD_{50}	3-week	1254	Mortality	>100 mg/kg-diet	19.5	Sanders & Kirkpatrick 1977 as cited in Eisler 1986
Raccoon	LD_{50}	8-day	1254	Mortality	>50 mg/kg-diet	2.5	Montz et al. 1982 as cited in Eisler 1986
Cottontail Rabbit	LD_{50}	12-week	1254	Mortality	>10 mg/kg-diet	0.6	Zepp & Kirkpatrick 1976 as cited in Eisler 1986
Mink	LD_{50}	Single dose	1254	Mortality	gavage	4000	Aulerich & Ringer 1977 as cited in Eisler 1986
Mink	LD_{50}	9-month	1254	Mortality	6.7 mg/kg-diet	1.5	Ringer et al. 1984 as cited in Eisler 1986
Rat (Male - S)	LD_{50}	Single dose	1260	Mortality	gavage in oil	1315	Linder et al 1974 as cited in ATSDR 1996
Rat	LD_{50}	Single dose	1260	Mortality		1300 - 10000	NAS 1979 as cited by Eisler 1986
Rat	LD_{50}	Single dose	1262	Mortality		1300 - 3200	EPA 1980, NAS 1979 as cited in Eisler 1986
Rat	LD_{50}	Single dose	1262	Mortality		11300	RTECS, Ann. Rev. Pharmacol., 1974
Rat	LOAEL	21-day	1016	Fertility		2	RTECS, Toxicologist 12:320, 1992
Mouse	LOAEL	6-week	1016	Immune Resistance	5 mg/kg-diet	0.65	Loose et al. 1978 as cited in IRIS 1996
Mink	LOAEL	18-month	1016	Kit Growth	25 mg/kg-diet	3.43	Aulerich & Ringer 1980 as cited in Sample et al. 1996
Mink	LOAEL	247-day	1016	Reproductive Succes and Postnatal Mortality	20 mg/kg-diet	3.80	Bleavins et al. 1980 as cited in IRIS 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals							
Test Species	**Endpoint**	**Duration**	**Anchor Form**	**Effect**	**Concentration**	**Dose (mg/kg-BW/day)**	**Reference**
Rhesus Monkey (Female)	LOAEL	18.2-month	1016	Birth Weight	in diet but conc. not provided	0.03	Levin et al. 1988 as cited in ATSDR 1996
Rhesus Monkey (Female)	LOAEL	18.2-month	1016	Birth Weight and Behavior	in diet but conc. not provided	0.03	Schantz et al. as cited in ATSDR 1996
Rhesus Monkey	LOAEL	22-month	1016	Birth Weights	1 mg/kg-diet	0.028	Barsotti & van Miller as cited in IRIS 1996
Rat (S/D)	LOAEL	Single dose	1242	Ataxia & Coma	gavage in oil	6000	Bruckner et al. 1973 as cited in ATSDR 1996
Rat (S/D)	LOAEL	2-month	1242	Increased Liver Weight	in diet but conc. not provided	0.3	Bruckner et al. 1974 as cited in ATSDR 1996
Rat (F-344)	LOAEL	21-day post natal	1242	Lethargy and Abnormal Behavior	gavage in oil	2.0	Pantaleoni et al. 1988 as cited in ATSDR 1996
Mouse (BALB/C)	LOAEL	6-week	1242	Reduced Resistance to Disease	in diet but conc. not provided	22.0	Loose et al. 1978 as cited in ATSDR 1996
Pig	LOAEL	91-day	1242	Reduced Growth	20 mg/kg-diet	9.2	Hansen et al. 1976 as cited in ATSDR 1996
Pig	LOAEL	16 weeks	1242	Birth Weights		5.8	RTECS, Amer. J. of Veterinary Research 36:23, 1975
Ferret	LOAEL	9-month	1242	Reproductive failure	20 mg/kg-diet	1.4	Bleavins et al. 1980 as cited in Fuller & Hobson 1986
Mink	LOAEL	7-months	1242	Reproductive failure	5 ppm of diet	0.69	Bleavins et al. 1980 as cited in Sample et al. 1996
Rat	LOAEL	6-weeks	1248	Growth	1000 mg/kg-diet	82	Allen & Abrahamson 1973 as cited in NIOSH 1977
Rat (Male W)	LOAEL	20-day	1248	Increased Liver Weight	in diet but conc. not provided	15	Kato et al. 1982 as cited in ATSDR 1996
Mouse (ARSF1)	LOAEL	5-week	1248	Reduced Resistance to Disease	in diet but conc. not provided	13.0	Thomas & Hinsdill 1978 as cited in ATSDR 1996
Mouse	LOAEL	26-weeks	1248	Increased Liver Weight		12.8	RTECS, Ach. Environ. Health 21:620, 1970
New Zealand Rabbit (Females)	LOAEL	4-weeks	1248	Growth of Offspring	250 mg/kg-diet	7.63	Thomas & Hinsdill 1980 as cited in IRIS 1996
New Zealand Rabbit (Females)	LOAEL	11-weeks	1248	Liver Histopathology in pups		28.0	Thomas & Hinsdill 1980 as cited in ATSDR 1996
Rhesus Monkey (Female)	LOAEL	7-months	1248	Reduced Live-Birth Rates	2.5 mg/kg-diet	0.1	Barsotti et al. 1976 as cited in Sample et al. 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals							
Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rhesus Monkey (Female)	LOAEL	2-months	1248	Decreased Conception	in diet but conc. not provided	4.3	Allen 1974 as cited in ATSDR 1996
Rhesus Monkey (Female)	LOAEL	18-month	1248	Infant Survival	in diet but conc. not provided	0.1	Allen & Barsotti 1976 as cited in ATSDR 1996
Rhesus Monkey (Female)	LOAEL	18-month	1248	Infant Survival	in diet but conc. not provided	0.1	Allen et al. 1980 as cited in ATSDR 1996
Rhesus Monkey (Female)	LOAEL	18.2-month	1248	Birth Weight and Behavior	in diet but conc. not provided	0.08	Levin et al. 1988 as cited in ATSDR 1996
Rhesus Monkey (Female)	LOAEL	18.2-month	1248	Birth Weight and Behavior	in diet but conc. not provided	0.08	Schantz et al. as cited in ATSDR 1996
Rhesus Monkey (Male)	LOAEL	2-months	1248	Gastric Ulceration	in diet but conc. not provided	4	Allen 1975; Allen & Norback 1976 as cited in ATSDR 1996
Rhesus Monkey (Male)	LOAEL	2-months	1248	Weight Loss	in diet but conc. not provided	12	Allen 1975; Allen & Norback 1976 as cited in ATSDR 1996
Rhesus Monkey (Male)	LOAEL	3-months	1248	Pericardial Edema, Gastric Ulceration, and Weight Loss	in diet but conc. not provided	12	Allen et al. 1973; Allen & Norback 1973 as cited in ATSDR 1996
Rat (Female W)	LOAEL	2-week	1254	Growth	in diet but conc. not provided	50	Kling et al. 1978 as cited in ATSDR 1996
Rat (W)	LOAEL	Gestation - Lactation	1254	Birth Weight, Growth, and Pup Survival	269 mg/kg-diet	13.5	Overman et al. 1987 as cited in IRIS 1996
Rat (S)	LOAEL	186-day	1254	Growth and Pup Survival	100 mg/kg-diet	7.2	Linder et al. 1974 as cited in IRIS 1996
Rat (S)	LOAEL	2-generation	1254	Reduced Litter Size	20 mg/kg-diet	1.5	Linder et al. 1974 as cited in IRIS 1996
Rat (W)	LOAEL	1-month	1254	Fertility, Litter Size, and Pup Survival	in diet but conc. not provided	30	Brezner et al. 1984 as cited in ATSDR 1996
Rat (S)	LOAEL	9-day - gestation	1254	Pup Survival	gavage in oil	100	Linder et al. 1974 as cited in ATSDR 1996
Rat (H)	LOAEL	9-day - lactation	1254	Decreased Fertility and Reproductive Success in F1 Generation	gavage in oil	8	Sager et al. 1987 as cited in ATSDR 1996
Rat (H)	LOAEL	9-day - lactation	1254	Decreased Fertility and Deveolpmental Effects	gavage in oil	32	Sager 1983 as cited in ATSDR 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals

Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rat (S/D)	LOAEL	10-day - gestation	1254	Fetal Body Weight and Survival	in diet but conc. not provided	5	Spencer 1982 as cited in ATSDR 1996
Rat (F-344)	LOAEL	5-week	1254	Increased Liver & Kidney Weights	gavage in oil	10	Andrews 1989 as cited in ATSDR 1996
Rat (F-344)	LOAEL	5-week	1254	Growth	gavage in oil	25	Andrews 1989 as cited in ATSDR 1996
Rat (Female S)	LOAEL	2-month	1254	Increased Liver Weight	in diet but conc. not provided	5	Goldstein et al. 1974 as cited in ATSDR 1996
Rat (Male F-344)	LOAEL	15-week	1254	Increased Liver Weight	gavage in oil	1	Gray et al. 1993 as cited in ATSDR 1996
Rat (Male F-344)	LOAEL	15-week	1254	Growth	gavage in oil	10	Gray et al. 1993 as cited in ATSDR 1996
Rat (Male F-344)	LOAEL	15-week	1254	Reduced Sperm Count	gavage in oil	25	Gray et al. 1993 as cited in ATSDR 1996
Rat (Male F-344)	LOAEL	104-week	1254	Decreased Survival	in diet but conc. not provided	2.5	NCI 1978 as cited in ATSDR 1996
Rat (Male F-344)	LOAEL	104-week	1254	Growth	in diet but conc. not provided	1.25	NCI 1978 as cited in ATSDR 1996
Rat (S)	LOAEL	8-month	1254	Growth	in diet but conc. not provided	36.4	Kimbrough et al. 1972 as cited in ATSDR 1996
Rat (W)	LOAEL	30-day	1254	Growth	in diet but conc. not provided	50.0	Kling et al. 1978 as cited in ATSDR 1996
Rat (W)	LOAEL	52-week	1254	Growth	in diet but conc. not provided	10	Phillips et al. 1972 as cited in ATSDR 1996
Rat (S/D)	LOAEL	10-gestation	1254	Decreased Fetal Weight	900 mg/kg-diet	21.5	HSDB, Spencer, Bull. Environ. Contam. Toxicol. 28:270, 1982
Rat (S/D)	LOAEL	35-day	1254	Liver Weight	in diet but conc. not provided	1.3	Bruckner et al. 1977 as cited in ATSDR 1996
Rat (W)	LOAEL	9-week	1254	Fetal Reabsorption	70 mg/L in drinking water	9.7	Baker et al 1977 as cited in Fuller & Hobson 1986
Mouse (Female ICR)	LOAEL	108-days	1254	Decreased Conception	in diet but conc. not provided	2.5	Welsh 1985 as cited in ATSDR 1996
Mouse (BALB/C)	LOAEL	11-month	1254	Liver Necrosis and Adenofibrosis	in diet but conc. not provided	49.8	Kimbrough & Linder 1974 as cited in ATSDR 1996
Mouse (BALB/C)	LOAEL	6-month	1254	Liver Weight and Necrosis	in diet but conc. not provided	4.88	Koller 1977 as cited in ATSDR 1996
Rabbit (NS)	LOAEL	28-day - gestation	1254	Fetotoxicity	gavage in oil	12.5	Villeneuve et al. 1971 as cited in ATSDR 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals							
Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rabbit (NZ)	LOAEL	14-week (dosed 1@wk)	1254	Reduced Uterus Size	Oral Intubation	300	Koller & Zinkle 1973 as cited in Fuller & Hobson 1986
Pig	LOAEL	182-days	1254	Fewer Pigs	in diet but conc. not provided	1.0	Earl et al. 1974 as cited in Fuller&Hobson 1986
Pig	LOAEL	11-day	1254	Gastric Ulceration	Gavage	100	Hansen et al. 1976 as cited in ATSDR 1996
Dog (Beagle)	LOAEL	60-day	1254	Fetal Reabsorbation	in diet but conc. not provided	5.0	Earl et al. 1974 as cited in Fuller&Hobson 1986
Dog (Beagle - male)	LOAEL	2-year	1254	Effects on Spermogenesis and Testes Size	100 mg/kg-diet	3.1	Kimbrough et al. 1973 as cited in Fuller & Hobson 1986
Mink	LOAEL	8-month	1254	Reproductive Failure	2 mg/kg-diet	0.4	Aulerich & Ringer 1977 as cited in IRIS 1996
Mink	LOAEL	6-month	1254	Offspring Mortality	1 mg/kg-diet	0.15	Wren et al. 1987 as cited in IRIS 1996
Mink	LOAEL	4-month	1254	Reproductive Failure	5 mg/kg-diet	0.69	Aulerich & Ringer 1977 as cited in Sample et al. 1996
Mink	LOAEL	28-day	1254	Growth	in diet but conc. not provided	1.8	Hornshaw et al. 1986 as cited in ATSDR 1996
Mink	LOAEL	90-day	1254	100% Stillbirths	in diet but conc. not provided	1.3	Kihlstrom et al. as cited in ATSDR 1996
White-Footed Mouse	LOAEL	2-3-weeks	1254	Frank Effect Level on Reproduction	400 mg/kg-diet	62	Sanders & Kirkpatrick 1975 as cited in Sample et al. 1996
White-Footed Mouse	LOAEL	60-day	1254	Reproductive Effects	200 mg/kg-diet	31	Merson & Kirkpatrick 1976 as cited in Sample et al. 1996
White-Footed Mouse	LOAEL	18-month	1254	Reduced Litter Size	10 mg/kg-diet	1.35	Linzey 1987 as cited in Sample et al. 1996
Oldfield Mouse	LOAEL	12-month	1254	Reduced Litter Size and Pup Survival	5 mg/kg-diet	0.68	McCoy et al. 1995 as cited in Sample et al. 1996
Rhesus Monkey	LOAEL	5-year	1254	Immune Response	in the diet adjusted to body weight	0.005	Tryphonas et al. 1991 as cited in IRIS 1996
Rhesus Monkey	LOAEL	14-month	1254	Birth Weight and Infant Growth	in the diet adjusted to body weight	0.025	Levinskas et al. 1984 as cited in IRIS 1996
Rhesus Monkey (Female)	LOAEL	14-month	1254	Fertility, Live Births, and Survival	in the diet adjusted to body weight	0.1	Levinskas et al. 1984 as cited in IRIS 1996
Rhesus Monkey (Female)	LOAEL	38-week	1254	Conception and Fetotoxicity	in diet but conc. not provided	0.2	Arnold et al. 1990 as cited in ATSDR 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals

Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rhesus Monkey (Female)	LOAEL	267-day	1254	Fetotoxicity and Development Effects	in the diet adjusted to body weight	0.1	Truelove et al. 1982 as cited in IRIS 1996
Rhesus Monkey (Female)	LOAEL	121-week	1254	Fetotixicty	in the diet adjusted to body weight	0.2	Tryphonas et al. 1986 as cited in IRIS 1996
Rat (Female S)	LOAEL	8-month	1260	Growth	in diet but conc. not provided	38.2	Kimbrough et al. 1972 as cited in ATSDR 1996
Rat (S)	LOAEL	67-day	1260	Litter Size	in diet but conc. not provided	35.4	Linder et al. 1974 as cited in ATDSR 1996
Rat	LOAEL	186-day	1260	Litter Size/Pup Survival	500 mg/kg-diet	40.8	Fuller&Hobson, Capt. 7 Vol 2 In PCBs and the Environ. CRC Press (1986)
Mink	NOAEL	18-month	1016	Reproduction/Kit Growth	10 mg/kg-diet	1.37	Aulerich & Ringer 1980 as cited in Sample et al. 1996
Mink	NOAEL	39-week	1016	Reproduction/Kit Growth	2 mg/kg-diet	0.4	Aulerich & Ringer 1977 as cited in IRIS 1996
Ferret	NOAEL	9-month	1016	Reproduction	20 mg/kg-diet	1.4	Beavins et al. 1980 as cited in Fuller & Hobson 1986
Rhesus Monkey (Female)	NOAEL	22-month	1016	Birth Weights and Learning Behavior	0.25 mg/kg-diet	0.007	Barsotti & van Miller as cited in IRIS 1996
Rhesus Monkey (Female)	NOAEL	18.2-month	1016	Birth Weight	in diet but conc. not provided	0.007	Levin et al. 1988 as cited in ATSDR 1996
Rhesus Monkey (Female)	NOAEL	18.2-month	1016	Birth Weight and Behavior	in diet but conc. not provided	0.007	Schantz et al. as cited in ATSDR 1996
Pig-tailed Macaque (Male)	NOAEL	20-week	1016	Clinical Signs, Growth	in the diet adjusted to body weight	3.2	Seegal et al. 1991 as cited in IRIS 1996
Rat (S/D)	NOAEL	2-month	1242	Growth	in diet but conc. not provided	1.5	Bruckner et al. 1974 as cited in ATSDR 1996
Rat (S/D)	NOAEL	10-day gestation	1242	Fertility of F1 generation	not specified	30	Gellart & Wilson 1979 as cited in Fuller & Hobson 1986
Rat (F-344)	NOAEL	21-day post natal	1242	Lethargy and Abnormal Behavior	gavage in oil	1	Pantaleoni et al. 1988 as cited in ATSDR 1996
Mink	NOAEL	247-day	1242	Growth and Gastric Ulceration	2 mg/kg-diet	0.9	Bleavins et al. 1980 as cited in ATSDR 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals							
Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rat	NOAEL	8-week	1248	Growth	300 mg/kg-diet	24.5	HSDB, Quazi, et al., Agri. Biol. Chem. 48:1581-1586, 1984
Rat	NOAEL	4-week	1248	Clinical Signs	100 mg/kg-diet	8.15	Alen et al. 1975 as cited in NIOSH 1977
New Zealand Rabbit (Females)	NOAEL	4-week	1248	Reproduction/Growth of Offspring	100 mg/kg-diet	3.05	Thomas & Hinsdill 1980 as cited in IRIS 1996
Rhesus Monkey (Female)	NOAEL	18.2-month	1248	Birth Weight and Behavior	in diet but conc. not provided	0.03	Schantz et al. as cited in ATSDR 1996
Rat (Male F-344)	NOAEL	4-day	1254	Growth	in diet but conc. not provided	3.9	Carter 1984 as cited in ATSDR 1996
Rat (Male F-344)	NOAEL	4-day	1254	Growth	in diet but conc. not provided	1.9	Carter 1985 as cited in ATSDR 1996
Rat (Male F-344)	NOAEL	2-week	1254	Growth	in diet but conc. not provided	1.9	Carter & Koo 1984 as cited in ATSDR 1996
Rat (Female W)	NOAEL	10-day gestation	1254	Reproductive Success	gavage in oil	100	Villeneuve et al. 1971 as cited in ATSDR 1996
Rat (S)	NOAEL	9-day - gestation	1254	Reproductive Success	gavage in oil	50	Linder et al. 1974 as cited in ATSDR 1996
Rat (H)	NOAEL	9-day - lactation	1254	Fertility and Deveolpment	gavage in oil	8	Sager 1983 as cited in ATSDR 1996
Rat (S/D)	NOAEL	10-day - gestation	1254	Fetal Body Weight and Survival	in diet but conc. not provided	2.5	Spencer 1982 as cited in ATSDR 1996
Rat (F-344)	NOAEL	5-week	1254	Liver & Kidney Weights	gavage in oil	1	Andrews 1989 as cited in ATSDR 1996
Rat (F-344)	NOAEL	5-week	1254	Growth	gavage in oil	10	Andrews 1989 as cited in ATSDR 1996
Rat (S/D)	NOAEL	35-day	1254	Liver Weight	in diet but conc. not provided	0.3	Bruckner et al. 1977 as cited in ATSDR 1996
Rat (Female S/D)	NOAEL	5-month	1254	Growth	in diet but conc. not provided	4.3	Byrne et al. 1987 as cited in ATSDR 1996
Rat (Female S)	NOAEL	2-month	1254	Growth	in diet but conc. not provided	5.0	Goldstein et al. 1974 as cited in ATSDR 1996
Rat (Male F-344)	NOAEL	15-week	1254	Liver Weight	gavage in oil	0.1	Gray et al. 1993 as cited in ATSDR 1996
Rat (Male F-344)	NOAEL	15-week	1254	Growth	gavage in oil	1	Gray et al. 1993 as cited in ATSDR 1996
Rat (Male F-344)	NOAEL	15-week	1254	Reproductive Success	gavage in oil	10	Gray et al. 1993 as cited in ATSDR 1996
Rat (W)	NOAEL	52-week	1254	Growth	in diet but conc. not provided	1	Phillips et al. 1972 as cited in ATSDR 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals							
Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Rat (S)	NOAEL	8-month	1254	Growth	in diet but conc. not provided	7.5	Kimbrough et al. 1972 as cited in ATSDR 1996
Mouse (BALB/C)	NOAEL	11-month	1254	Growth	in diet but conc. not provided	49.8	Kimbrough & Linder 1974 as cited in ATSDR 1996
Mouse (BALB/C)	NOAEL	6-month	1254	Liver Weight and Necrosis	in diet but conc. not provided	0.49	Koller 1977 as cited in ATSDR 1996
Mouse (ICR)	NOAEL	108-days through gestation	1254	Fertility, Litter Size, Devolpment, Growth	100 mg/kg-diet	12.5	Welsh 1985 as cited in IRIS 1996
Rabbit (NZ)	NOAEL	8-week	1254	Body Weight	in diet but conc. not provided	6.5	Street & Sharma 1975 as cited in ATSDR 1996
Rabbit (NS)	NOAEL	28-day - gestation	1254	Reproduction	gavage in oil	10	Villeneuve et al. 1971 as cited in ATSDR 1996
Cow	NOAEL	180-day	1254	Reproduction	1000 mg/day	3	HSDB, Willett, et al., Fundam. Appl. Toxicol. 9:60, 1987
Dog (Beagle)	NOAEL	60-day (Including gestation)	1254	No effects on reproduction		1.0	Earl et al. 1974 as cited in Fuller & Hobson 1986
Mink	NOAEL	4.5-month	1254	Reproduction	1 mg/kg-diet	0.14	Aulerich & Ringer 1977 as cited in Sample et al. 1996
Mink	NOAEL	28-day	1254	Growth	in diet but conc. not provided	1.1	Hornshaw et al. 1986 as cited in ATSDR 1996
Rat	NOAEL	8-month	1254	Survival	200 mg/kg-diet	16.3	EPA 440/5-80-068, 1980
Rat (S)	NOAEL	2-generation	1254	Reproduction & Litter Size	5 mg/kg-diet	0.32	Linder et al. 1974 as cited in IRIS 1996
White-footed Mouse	NOAEL	21-day gestation	1254	Reproductive Effects	100 mg/kg-diet	15.45	Sanders & Kirkpatrick 1977 as cited in Fuller & Hobson 1986
Rhesus Monkey	NOAEL	37-month	1254	Growth	in diet but conc. not provided	0.08	Arnold et al. 1993 as cited in ATSDR 1996
Rhesus Monkey	NOAEL	14-month	1254	Birth Wieght and Infant Growth	in the diet adjusted to body weight	0.005	Levinskas et al. 1984 as cited in IRIS 1996
Rat (Female S)	NOAEL	8-month	1260	Growth	in diet but conc. not provided	7.2	Kimbrough et al. 1972 as cited in ATSDR 1996
Rat (Male S)	NOAEL	8-month	1260	Growth	in diet but conc. not provided	38.2	Kimbrough et al. 1972 as cited in ATSDR 1996
Rat (S)	NOAEL	67-day	1260	Reproduction	in diet but conc. not provided	6.9	Linder, et al. 1974 as cited in ATSDR 1996
Rat (S)	NOAEL	367-day	1260	Growth	in diet but conc. not provided	5	Kimbrough et al. 1975 as cited in ATSDR 1996

Polychlorinated Biphenyls Oral Toxicity - Mammals

Test Species	Endpoint	Duration	Anchor Form	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
G. Pig (Female)	NOAEL	8-week	1260	Clinical Signs	in diet but conc. not provided	2	Vos & de Roij 1972 as cited in ATSDR 1996
Big Brown Bat	NOAEL	22-day	1260	Survival & Growth	6.36 mg/kg-diet	0.885	TERRETOX, Clark Bull. Environ. Contam. Toxicol. 19:707-714, 1978
Rat	NOAEL	1-day	1262	Serum Enzymes		8	Fuller&Hobson, Capt. 7 Vol 2 In PCBs and the Environ. CRC Press (1986)
Average Cattle Body Weight = 329 kg Reference is USEPA, 1988 EPA/60/6-87/008							
Adult Raccoon Body Weight = (average of male & female) = 5.616 kg; Reference is USEPA, 1993; EPA/600/R-93/187a							
Adult Raccoon Food Consumption = (based on all mammals) = 0.0687 x BW(kg) $^{0.822}$, Reference is USEPA, 1993; EPA/600/R-93/187a							
Mature Mink Body Weight = (average male & female) = 1.0195 kg; Reference is USEPA, 1993, EPA/600/R-93/187a							
Mature Mink Food Consumption = (average male & female) = 0.2214 kg/day, Reference is USEPA, 1993, EPA/600/R-93/187a							
Mature White Footed Mouse Body Weight = (average male & female) = 0.021 kg; Reference is USEPA, 1993, EPA/600/R-93/187a							
Mature White-footed Mouse Food Consumption = (average male & female) = 0.195 g/g-BW/day, Reference is USEPA, 1993, EPA/600/R-93/187a							
Adult Cottontail Rabbit Body Weight = (average of male & female) = 1.189 kg; Reference is USEPA, 1993; EPA/600/R-93/187a							
Adult Cottontail Rabbit Food Consumption = (based on rodents) = 0.0621 x BW(kg) $^{0.564}$, Reference is USEPA, 1993; EPA/600/R-93/187a							
Mature Rat Body Weight = (average male & female) = 0.325 kg, Reference is USEPA, 1987, EPA/600/6-87/008							
Mature Rat Food Consumption = (average male & female) = 0.0265 kg/day, Reference is USEPA, 1987, EPA/600/6-87/008							
Mature Sprague-Dawley Rat Body Weight = (average male & female) = 0.475 kg, Reference is USEPA, 1987, EPA/600/6-87/008							
Mature Winstar Rat female body weight = 0.297 kg; Reference is USEPA, 1987, EPA/600/6-87/008							
Mature Winstar Rat female water ingestion = 0.041 L/day; Reference is USEPA, 1987, EPA/600/6-87/008							
Mature Sprague-Dawley Rat Food Consumption = (average male & female) = 0.034 kg/day, Reference is USEPA, 1987, EPA/600/6-87/008							
White-Footed Mouse body weight = 0.022 kg; Reference is Green & Miller 1987 as cited in Sample et al. 1996							
White-Footed Mouse food ingestion = 0.0034 kg/day; Reference is Green & Miller 1987 as cited in Sample et al. 1996							
Average Pig Body Weight = 225 kg, Food Ingestion = 4.5 kg/day, Reference is USEPA, 1987 EPA/600/6-87/008							
New Zealand Rabbit female body = 3.93 kg; Reference is USEPA, 1988 EPA/60/6-87/008.							
New Zealand Rabbit female food ingestion = 0.12 kg/day; Reference is USEPA, 1988 EPA/60/6-87/008.							
Beagle Dog body weight = 14 kg; Reference is USEPA, 1988 EPA/60/6-87/008.							
Beagle Dog body food ingestion = 0.435 kg/day; Reference is USEPA, 1988 EPA/60/6-87/008.							
Ferret Body Weight = 0.915 kg; Reference is Nowak 1991.							
Ferret Food ingestion (based on all mammals) = 0.0687 x BW(kg) $^{0.822}$, Reference is USEPA, 1993; EPA/600/R-93/187a.							
Big Brown Bat body (average for USA) = 0.019 kg; Reference is Silva & Downing 1995							
Big Brown Bat Food ingestion (based on all mammals) = 0.0687 x BW(kg) $^{0.822}$, Reference is USEPA, 1993; EPA/600/R-93/187a.							

Polychlorinated Biphenyls Oral Toxicity - Birds

Test Species	Endpoint	Duration	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
N. Bobwhite	LD_{50}	5 days (1242)	Mortality	2098 mg/kg diet		Heath et al. 1972 as cited in Eisler 1986
Mallard	LD_{50}	5 days (1242)	Mortality	3182 mg/kg diet	177	Heath et al. 1972 as cited in Eisler 1986
Pheasant	LC_{50}	5 days (1242)	Mortality	2078 mg/kg diet	121	Heath et al. 1972 as cited in Eisler 1986
Bobwhite	LD_{50}	5-day (1248)	Mortality	1175 mg/kg-diet	478	Heath et al. 1972 as cited in Eisler 1986
Japanese Quail	LD_{50}	5-day (1248)	Mortality	4844 mg/kg-diet	1972	Heath et al. 1972 as cited in Eisler 1986
Pheasant	LD_{50}	5-day (1248)	Mortality	1312 mg/kg-diet	76.3	Heath et al. 1972 as cited in Eisler 1986
Mallard	LD_{50}	5-day (1248)	Mortality	2798 mg/kg-diet	156	Heath et al. 1972 as cited in Eisler 1986
Mallard	LD_{50}	Single dose (1254)	Mortality		>2000	NAS 1979 as cited in Eisler 1986
Bobwhite	LD_{50}	5-day (1254)	Mortality	604 mg/kg-diet	167	Heath et al. 1972 as cited in Eisler 1986
Japanese Quail	LD_{50}	5-day (1254)	Mortality	2898 mg/kg-diet	706	Heath et al. 1972 as cited in Eisler 1986
Mallard	LD_{50}	5-day (1254)	Mortality	2699 mg/kg-diet	347	Heath et al. 1972 as cited in Eisler 1986
Pheasant	LD_{50}	5-day (1254)	Mortality	1091 mg/kg-diet	63.5	Heath et al. 1972 as cited in Eisler 1986
Starling	LD_{50}	4-day (1254)	Mortality	1500 mg/kg-diet	248	Stickel et al. 1984 as cited in Eisler 1986
Red Wing Blkbird	LD_{50}	6-day (1254)	Mortality	1500 mg/kg-diet	248	Stickel et al. 1984 as cited in Eisler 1986
Cowbird	LD_{50}	7-day (1254)	Mortality	1500 mg/kg-diet	248	Stickel et al. 1984 as cited in Eisler 1986
Mallard	LD_{50}	Single dose (1260)	Mortality		>2000	NAS 1979 as cited by Eisler 1986
Pheasant	LD_{50}	5-day (1260)	Mortality	1260 mg/kg-diet	73.3	Heath et al. 1972 as cited in Eisler 1986
Mallard	LD_{50}	5-day (1260)	Mortality	1975 mg/kg-diet	254	Heath et al. 1972 as cited in Eisler 1986
Japanese Quail	LD_{50}	5-day (1260)	Mortality	2186 mg/kg-diet	533	Heath et al. 1972 as cited in Eisler 1986
Bobwhite	LD_{50}	5-day (1260)	Mortality	747 mg/kg-diet	207	Heath et al. 1972 as cited in Eisler 1986
Pheasant	LD_{50}	5-day (1262)	Mortality	1234 mg/kg-diet		TERRETOX, Heath et al. US Bureau Sport Fish. Wild., 152:1-57, 1972
Mallard	LD_{50}	5-day (1262)	Mortality	3008 mg/kg-diet	386	TERRETOX, Heath et al. US Bureau Sport Fish. Wild., 152:1-57, 1972
Japanese Quail	LD_{50}	5-day (1262)	Mortality	2291 mg/kg-diet	558	TERRETOX, Heath et al. US Bureau Sport Fish. Wild., 152:1-57, 1972
Japanese Quail	LD_{50}	5-day (1262)	Mortality	2304 mg/kg-diet	562	Hill & Camardese, USFWS, Tech. Rpt 2, 1986
Bobwhite	LD_{50}	5-day (1262)	Mortality	871 mg/kg-diet	212	TERRETOX, Heath et al. US Bureau Sport Fish. Wild., 152:1-57, 1972
Chicken	LOAEL	9-weeks (1242)	Reduced Hatch	20 mg/kg of diet	0.8	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Japanese Quail	LOAEL	9-weeks (1242)	Reduced Egg Production	100 mg/kg-diet	40.7	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)

Polychlorinated Biphenyls Oral Toxicity - Birds

Test Species	Endpoint	Duration	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Chicken	LOAEL	9-weeks (1248)	Reduced Hatch/Growth	20 mg/kg of diet	0.8	HSDB, Little, etal.; Pol. Sci. 53:726-32 (1974)
Chicken	LOAEL	8-weeks (1248)	Reduced Hatch	10 mg/kg of diet	0.40	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Japanese Quail	LOAEL	56-days (1248)	Reduced Hatch	200 mg/kg-diet	15.6	TERRETOX, Scott et al. Poultry Sci.54:350-368, 1975
American Kestrel	LOAEL	Not Reported (1248)	Reproductive Success	3 mg/kg-diet	0.9	TERRETOX, Lowe & Stendell, Ach. Environ. Contam Toxicol. 20:519-522, 1991
Chicken	LOAEL	39-weeks (1254)	Egg Production/Fertility		2.44	RTI, 1994
Chicken	LOAEL	Not Reported (1254)	Chick Growth		0.98	RTI, 1994
Japanese Quail	LOAEL	3-weeks (1254)	Reduced Egg Production	78 mg/kg-diet	31.8	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Turtle Dove	LOAEL	3-month (1254)	Reproductive Effects	10 mg/kg-diet	1.1	Heinz et al. 1984 as cited in Eisler 1986
Mourning Dove	LOAEL	6-week (1254)	Reproductive Effects	10 mg/kg-diet	1.1	Tori & Peterle 1983 as cited in Eisler 1986
Ring Dove	LOAEL	12-weeks (1254)	Reproductive Effects	10 mg/kg of diet	1.1	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Am. Kestrel	LOAEL	62-69-day (1254)	Spermagenesis	33 mg/kg-diet	9 to 10	Bird et al. 1983 as cited in Eisler 1986
Pheasant	LOAEL	17-weeks (1254)	Reduced Clutch Size	12.5 mg/week	1.8	Dahlgren, et al. 1972 as cited in Sample et al. 1996
Japanese Quail	LOAEL	3-weeks (1260)	Reduced Egg Production	62.5 mg/kg-diet	25.4	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Bobwhite Quail	LOAEL	14-weeks (1260)	Reduced Egg Production	500 mg/kg-diet	204	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Mallard	NOAEL	12-weeks (1242)	Reproductive Effects	150 mg/kg of diet	8.4	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Japanese Quail	NOAEL	20-day (1242)	Survival	250 mg/kg-diet	102	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Pigeon	NOAEL	28-day (1242)	Survival	500 mg/kg-diet	55.8	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Mallard	NOAEL	84-day (1242)	Survival	150 mg/kg-diet	8.4	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Chicken	NOAEL	9-weeks (1248)	Reproduction/Growth	2 mg/kg of diet	0.10	HSDB, Little, etal.; Pol. Sci. 53:726-32 (1974)
Japanese Quail	NOAEL	56-days (1248)	Reproductive Effects	100 mg/kg-diet	7.8	TERRETOX, Scott et al. Poultry Sci.54:350-368, 1975

Polychlorinated Biphenyls Oral Toxicity - Birds						
Test Species	Endpoint	Duration	Effect	Concentration	Dose (mg/kg-BW/day)	Reference
Screech Owl	NOAEL	2-breeding seasons (1248)	Reproductive Effects	3 mg/kg-diet	0.4	McLane & Huges 1980 as cited in Eisler 1986
Japanese Quail	NOAEL	8-weeks (1248)	Reproductive Effects	20 mg/kg-diet	8.1	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Japanese Quail	NOAEL	Long-Term (1254)	Reproductive Effects	50 mg/kg-diet	3.9	NAS 1979 as cited in Eisler 1986
Bobwhite Quail	NOAEL	Long-Term (1254)	Reproductive Effects	50 mg/kg-diet	3.9	NAS 1979 as cited in Eisler 1986
Mallard	NOAEL	2-seasons (1254)	Reproductive Effects	25 mg/kg-diet	1.4	Custer & Heinz 1980 as cited in Eisler 1986
Chicken	NOAEL	9-weeks (1254)	Reproductive Effects	2 mg/kg-diet	0.10	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Ring Dove	NOAEL	56-day (1254)	Survival	100 mg/kg-diet	11.2	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
White pelican	NOAEL	70-day (1254)	Survival	144 mg/kg-diet	27.2	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)
Am. Kestrel	NOAEL	100-day (1254)	Survival	5 mg/kg-diet	0.62	Peakall, Capt. 3 Vol 2 In PCBs and the Environ. CRC Press (1986)

10-day old Quail Body Weight = 10 to 13 g (average = 0.0115 kg) Reference is USEPA, 1993, EPA/600/R-93/187a

14-day old Quail Body Weight = 13 to 20 g (average = 0.0165 kg), Reference is USEPA, 1993 EPA/600/R-93/187a

10-day old Mallard Body Weight = 92 to 115 g (average = 0.1035 kg), Reference is USEPA, 1993 EPA/600/R-93/187a

Red Winged Blackbird Body Weight = (mid-point in range) 0.05 kg Reference is Dunning, 1993

Bird Food Ingestion (based on all birds, kg/day) = 0.0582 x Body Weight (kg) $^{0.651}$ Reference is USEPA, 1993 EPA/600/R-93/187a

Adult Quail Body Weight = (average over seasons) = 0.191 kg Reference is USEPA, 1993, EPA/600/R-93/187a

Adult Quail Food Consumption = (average over seasons) = 0.07776 g/g-BW Reference is USEPA, 1993, EPA/600/R-93/187a

Adult Mallard Body Weight = (average male & female) = 1.134 kg Reference is USEPA, 1993, EPA/600/R-93/187a

Adult Robin Body Weight (for dove, cowbird & starling) = (average over seasons) = 0.0773 kg Reference is USEPA, 1993, EPA/600/R-93/187a

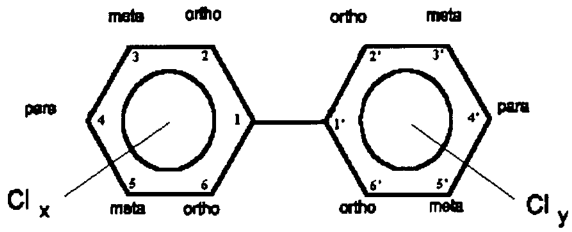
Adult Robin Food Consumption (for dove, cowbird, & starling) = (average over seasons) = 1.205 g/g-BW Reference is USEPA, 1993, EPA/600/R-93/187a

Average Chicken Body Weight (female) =1.6 kg Reference is USEPA, 1987 EPA/600/6-87/008 (used USEPA 1993 formula for all birds for Food Consumption)

Average Kestrel Body Weight =0.116 kg Reference is USEPA, 1993 EPA/600/R-93/187 used USEPA 1993 formula for all birds for Food Consumption)

Average Dove Body Weight =0.155 kg Reference is Opresko, et al. 1994 used USEPA 1993 formula for all birds for Food Consumption)

Average Pelican Body Weight = 3.5 kg, Food ingestion 0.66 kg/day, Reference is Opresko, et al. 1994



PCBs

Polychlorinated biphenyls (PCBs) are semi-synthetic oils. They are made from biphenyl, a naturally occurring compound extracted from petroleum. Chlorination of biphenyl results in a mixture that consists of heavy, nonflammable, stable PCBs with high boiling points. PCBs have been used commercially as coolants, hydraulic fluids, stone-cutting oils, and heat transfer fluids. PCBs have also been used in plasticizer processes and as dye carriers.

Chemical information (EPA, 1989):

CAS Number 1336-36-3
MW 154.2 to 498.7
VP 2.8 x 10^{-9} to 7.6 x 10^{-5} mm Hg
Slightly Soluble
Log Kow 4.0 to 6.9

Polychlorinated biphenyls are exceptionally persistent in the environment and are fairly ubiquitous in soils and waterways. In general persistence relates to the degree of chlorination, with the more highly chlorinated forms being more resistant to biodegradation and more persistent in the environment. The primary routes of potential human exposure to polychlorinated biphenyls are ingestion, inhalation, and dermal contact. PCBs are highly lipophilic compounds which are readily absorbed and tend to accumulate in the body.

A large body of knowledge about the human toxicity of PCBs comes from two large-scale incidents, the Yusho incident in Japan in 1968 (Kuratsune M et al. 1972) and the Yu-Cheng incident in Taiwan in 1979 (Chen et al., 1985a). These two incidents are unique in that exposures to PCBs were unusually high. Other human health effects due to PCBs have been investigated in industrial exposure incidents and follow-up epidemiological studies. It is generally agreed that for certain toxicity endpoints, PCB congeners with co-planer structures are of greatest toxicological significance, and that this toxicity is mediated through a 2,3,7,8-tetrachlorodibenzo-p-dioxin like interaction with the aryl hydrocarbon (AH) receptor. A toxic equivalency factor approach to the TCDD-like endpoint has been proposed for coplanar PCBs (Safe, 1990).

The primary systemic toxic responses associated with PCB exposure include chloracne, hyperpigmentation of the skin, nails, and conjunctival and raucous membranes, liver disease, hyperactive meibomian glands; conjunctivitis; edema of eyelids; subcutaneous edema; keratin cysts in hair follicles; hyperplasia of hair follicle epithelium; hepatic hypertrophy; decreased number of red blood cells; decreased hemoglobin; serum hyperlipidemia; leucocytosis (IARC, 1978; Braverman, 1992). Some neurotoxic effects have been observed among PCB-exposed populations, including headache, numbness, altered peripheral nerve conduction velocity (Chen et al., 1985b) and decreased neurobehavioral function as measured by visual memory, problem solving and mean choice reaction time (Kilburn et al., 1989). PCB exposure is also associated with involution of the thymus and with impaired humoral and cellular immunity (Tryphonas et al., 1991).

The reproductive and developmental toxic effects of PCBs have been extensively studied in rodents, monkeys, and humans. In women exposed to PCBs in Yusho and Yu-cheng incidents, irregular menstrual cycles, increased incidence of miscarriage and the birth of small, hyperpigmented and hyperkeratotic infants have been observed. In animal studies, increased menses duration, decreased estrogen and progesterone peaks, and increased incidence of miscarriage were observed after PCB exposure (Allen et al., 1979; Truelove et al. 1990). The primary developmental toxic effects consisted of lower birth weight and persistent motor and cognitive deficits in children who were prenatally exposed to PCBs (Rogan et al., 1988). Mother's milk contaminated with PCBs appears to be a source of exposure for infants. Developmental abnormalities have been observed in PCB-intoxicated infants. Premature eruption of teeth, enlarged frontal and occipital fontanelles, exophthalmos and the maintenance of an abnormally wide sagittal suture were observed (IARC, 1978; Gladen et al. 1988).

Most genotoxicity studies demonstrated PCB congeners are not genotoxic. However, genotoxic effects were demonstrated in human lymphocyte cultures (Sargent et al., 1989) and increased chromosomal damage was reported in an occupationally exposed population (Kalina et al., 1991).

The carcinogenicity of PCBs has been reviewed in detail by Silberhorn et al. (1990). Current epidemiological evidence does not provide sufficient evidence of PCB carcinogenicity in humans to establish a causal relationship, although several studies suggest a possible association between PCB exposure and certain types of cancer (Brown, 1987; NIOSH, 1991). Aroclor 1260 has been shown to induce hepatocellular carcinoma in Sprague-Dawley rats (Norback and Weltman, 1985). Some coplanar and some noncoplanar congeners have demonstrated promoting ability, although with marked differences in potency (Silberhorn et al., 1990).

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Several applicable or relevant and appropriate requirements (ARARs) are available for PCBs in soils. They are the applicable spill cleanup levels under the Toxic Substances Control Act (TSCA), the Land Disposal Restrictions (LDRs) under the Resource Conservation and Recovery Act, and action levels developed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (commonly known as "Superfund"). In addition, under the PCB Mega Rule (40 CFR 761.61[c]) (63 FR 35384, June 29, 1998), site-specific risk-based cleanup goals can be developed based on EPA risk assessment methodology. The derived level, if approved by the EPA TSCA Office, will be considered site-specific and applicable soil cleanup requirement.

Under TSCA regulations 40 CFR 761.61(a)(4)(i) that governs the self-implementing on-site cleanup and disposal of remediation waste program, cleanup levels are provided for bulk remediation waste. Bulk remediation waste includes soil, sediments, dredged materials, muds, PCB sewage sludge, and industrial sludge. These levels are:

- For high-occupancy areas, when the soil cleanup level is ≤ 1 ppm, no further actions are required. Where bulk remediation waste remains at concentrations > 1ppm and ≤ 10 ppm, the soil shall be covered with a cap meeting the requirements of paragraph a (7) and a (8) of 40 CFR 761.61. High occupancy area means any area where PCB remediation waste has been disposed of on site and where occupancy for any individual not wearing dermal and respiratory protection for a calendar year is 335 hours or more (an average of 6.7 hours or more per week). Examples could include a residence, school, day care center, sleeping quarters, a single or multiple occupancy 40 hours per week work station, a school class room, a cafeteria in an industrial facility, a control room, and a work station at an assembly line.
- For low-occupancy areas, three levels are provided:
  - ➢ 25 ppm
  - ➢ > 25 ppm and ≤ 50 ppm if the site is secured by a fence and marked with sign including the M_L mark
  - ➢ > 25 ppm and ≤ 100 ppm if the site is covered with a cap meeting the requirements of paragraph a (7) and a (8) of this section

  Low occupancy area means any area where PCB remediation waste has been disposed of on site and where occupancy for any individual not wearing dermal and respiratory protection for a calendar year is less than 335 hours (less than an average of 6.7 hours). Examples could include an electrical substation or a location in an industrial facility where a worker spends small amounts of time per week (such as an unoccupied area outside a building, an electrical equipment vault, or in the non-office space in a warehouse where occupancy is transitory).

Under the Resource Conservation and Recovery Act (RCRA) land disposal restriction (LDR) regulations, Sec. 268.32 applies to waste specific prohibitions--Soils exhibiting the toxicity characteristic for metals and containing PCBs. The regulations provides: (a) Effective December 26, 2000, the following wastes are prohibited from land disposal: any volumes of soil exhibiting the toxicity characteristic solely because of the presence of metals (D004--D011) and containing PCBs or (b) The requirements of paragraph (a) of this section do not apply if: (1)(i) The wastes contain halogenated organic compounds (HOCs) in total concentration less than 1,000 mg/kg; and (ii) The wastes meet the treatment standards specified in Subpart D of this part for EPA hazardous waste numbers D004--D011, as applicable; or (2)(i) The wastes contain halogenated organic compounds in total concentration less than 1,000 mg/kg; and (ii) The wastes meet the alternative treatment standards specified in Sec. 268.49 for contaminated soil; or (3) Persons have been granted an exemption from a prohibition pursuant to a petition under Sec. 268.6, with respect to those wastes and units covered by the petition; or (4) The wastes meet applicable alternative treatment standards established pursuant to a petition granted under Sec. 268.44. HOCs include PCBs, specifically, Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, and PCBs not otherwise specified.

Under the Comprehensive Emergency Response, Compensation, and Liability Act, EPA issued an Office of Solid Waste and Emergency Response (OSWER) directive in August 1990 (A Guide on Remedial Actions for Superfund Sites with PCB Contamination, OSWER Directive 9355.4-01FS, PB91-921 206). The directive provides preliminary remdiation goals for various media that may be contaminated with PCBs. Based on generic exposure assumptions and Aroclor 1254, the levels of residential (1 ppm) and industrial (10-25 ppm) were recommended. The guidance states that other factors that may affect these levels include the potential for PCBs to migrate to groundwater and to affect environmental receptors. Also, the guidance cautions that because of the persistence and pervasiveness of PCBs, PCBs will be present in background samples at many sites. For sites in industrial areas, action levels generally should be established within the range of 10 to 25 ppm. The appropriate concentration within the range will depend on site-specific factors that affect the exposure assumptions. For example, at sites where exposures will be very limited or where soil is already covered with concrete, PCB concentration near the high-end of the 10-to-25 ppm range may be protective of human health and the environment. In the discussion of development of remedial alternatives, the guidance states further that, "For residential sites, principal threats will generally include soils contaminated at concentration greater than 100 ppm PCBs. For industrial sites, principal threats will include soils contaminated at concentrations greater than or equal to 500 ppm PCBs. Table 3 of the guidance shown below presents a range of long-term management controls to be considered for PCB-contaminated sites.

Selection of Long-Term Management Controls To Be Considered for PCB-Contaminated Sites

PCB - Concentration (ppm)	Approximate Depth to Ground Water	Access	RCRA Corollary	Long-Term Management Controls Reccomended: Cover System [1]	Leachate Collection	Leak Detection	Bottom Liner	Ground Water Monitoring	Surface Water Monitoring	Surface Water Management	Chemical Waste Landfill Requirements: Bottom Liner	Depth to Ground Water	Ground Water Monitoring	Leachate Collection	Surface Water Monitoring	Fence	Potential Basis for TSCA Waiver (761.75 (c) (4)) of Indicated Chemical Waste Landfill Requirement(s)
≤ 1	All Depths	• Nonrestricted Access	Clean Closure														No waivers required; clean closure
1-10	All Depths	• Nonrestricted Access	Hybrid Closure	2							X	3	X	X	X	X	Low PCB concentration Design and installation of a protective cover system Evaluation of PCB migration to GW and SW
10-25	All Depths	• Limited Access • Deed Notice	Hybrid Closure	2							X	3	X	X	X	X	Low PCB concentration Design and installation of a protective cover system Evaluation of PCB migration to GW and SW
25-100	All Depths	• Restricted Access • Fence • Deed Notice	Landfill Closure	X				X		4	X	3		X	X		Relatively low PCB concentration Implementation of a GW monitoring program Evaluation of PCB migration to GW and SW Design and installation of a protective cover system
100-500	3-50 Feet	• Restricted Access • Fence • Deed Notice	Landfill Closure	X				X	X	4	X	X		X			Implementation of GW monitoring program Design and installation of a protective cover system Evaluation of PCB migration to GW and SW
	> 50 Feet	• Restricted Access • Fence • Deed Notice	Landfill Closure	X				5	X	4	X		X	X			Design and installation of a protective cover system Demonstrate sufficient depth to GW to protect human health and the environment Evaluation of PCB migration to GW and SW
> 500	3-50 Feet	• Restricted Access • Fence • Deed Notice	Landfill Closure Minimum Technology	X	X	X	X	X	X	4		X					Demonstrate other long-term management controls to provide adequate protection of GW
	> 50 Feet	• Restricted Access • Fence • Deed Notice	Landfill Closure Minimum Technology	X	X	X	X	X	X	4	X			X			Demonstrate sufficient depth to GW and long-term management controls to protect human health and the environment Implementation of GW monitoring program Evaluation of PCB migration to GW and SW

GW = ground water; SW = surface water

[1] Cover system may range from 12" soil cap for low concentrations to a full RCRA cap for concentrations exceeding 500 ppm.

[2] The need for a cover system will depend on the land use (i.e., residential or industrial).

[3] 40 CFR 761.75(b)(3) requires that landfills be located at least 50 feet above the high-water table.

[4] In accordance with 40 CFR 761.75(b)(4) if the site is located below the 100-year floodwater elevation, diversion dikes shall be constructed around the perimeter of the landfill site with a minimum height equal to 2 feet above the 100-year floodwater elevation. Flood protection for landfills above the 100-year floodwater elevation is not applicable to closed landfill units.

[5] When the site is located in a permeable formation, incorporation of this long-term management control should be evaluated.